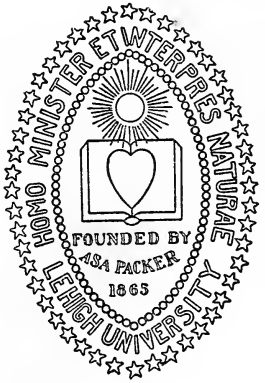
REGISTER

OF

LEHIGH UNIVERSITY



1915-1916

SOUTH BETHLEHEM,
PENNSYLVANIA

1915

JULY.

S	M	T	W	T	F	S
...	...	...	...	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
...	...	...	...	...	...	...

AUGUST.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	...	...	...	...
...	...	...	...	...	...	...

SEPTEMBER.

S	M	T	W	T	F	S
...	...	...	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	...	...
...	...	...	...	...	...	...

OCTOBER.

S	M	T	W	T	F	S
...	..	...	...	...	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	...	...	...	...	...	...

NOVEMBER.

S	M	T	W	T	F	S
...	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	...	...	...	...
...	...	...	...	...	...	...

DECEMBER.

S	M	T	W	T	F	S
...	...	...	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	...
...	...	...	...	...	...	...

1916

JANUARY.

S	M	T	W	T	F	S
...	...	...	...	...	...	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	...	...	...	...	...

FEBRUARY.

S	M	T	W	T	F	S
...	...	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	...	...	...	...
...	...	...	...	...	...	...

MARCH.

S	M	T	W	T	F	S
...	...	...	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	...
...	...	.	...	...	...	...

APRIL.

S	M	T	W	T	F	S
...	...	...	...	...	...	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	...	...	...	...	...	...

MAY.

S	M	T	W	T	F	S
...	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	...	...	...
...	...	...	...	...	...	...

JUNE.

S	M	T	W	T	F	S
...	...	...	...	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	...
...	...	...	...	...	...	...

JULY.

S	M	T	W	T	F	S
...	...	...	...	...	...	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	...	...	...	...	...

AUGUST.

S	M	T	W	T	F	S
...	...	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	...	...
...	...	...	...	...	...	...

SEPTEMBER.

S	M	T	W	T	F	S
...	...	...	...	...	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
...	...	...	...	...	...	...

OCTOBER.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	...	...	...	...
...	...	...	...	...	...	...

NOVEMBER.

S	M	T	W	T	F	S
...	...	...	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	...	...
...	...	...	...	...	...	...

DECEMBER.

S	M	T	W	T	F	S
...	...	...	...	...	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	...	...	...	...	...	...

1917

JANUARY.

S	M	T	W	T	F	S
...	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	...	...	...
...	...	...	...	...	...	...

FEBRUARY.

S	M	T	W	T	F	S
...	...	...	...	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	...	...	...
...	...	...	...	...	...	...

MARCH.

S	M	T	W	T	F	S
...	...	...	...	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
...	...	...	...	...	...	...

APRIL.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	...	...	...	...	...
...	...	...	...	...	...	...

MAY.

S	M	T	W	T	F	S
...	...	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	...	...
...	...	...	...	...	...	...

JUNE.

S	M	T	W	T	F	S
...	...	...	...	...	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
...	...	...	...	...	...	...

CALENDAR

1915	1915–1916
Sept. 10, 11, 13, 14, (Friday, Saturday, Monday, Tuesday)	Examinations for Admission.
Sept. 15, 3.30 P.M., (Wednesday)	First Term begins.
Oct. 2, (Saturday)	Founder's Day.
Nov. 24, 12.00 M., (Wednesday)	Thanksgiving Recess begins.
Nov. 29, 7.45 A. M., (Monday)	Thanksgiving Recess ends.
Dec. 23, 12.00 M., (Thursday)	Christmas Holidays begin.
1916	
Jan. 4, 7.45 A.M. (Tuesday)	Christmas Holidays end.
Jan. 21, 8.00 A. M., (Friday)	Examinations begin.
Jan. 28, 5.00 P. M., (Friday)	Examinations end.
Jan. 31, 7.45 A. M., (Monday)	Second Term begins.
Feb. 22, (Tuesday)	Washington's Birthday Cele-
April 19, 12.00 M., (Wednesday)	Easter Holidays begin. [bration.
April 25, 7.45 A. M., (Tuesday)	Easter Holidays end.
April 27, 5.00 P.M., (Thursday)	Short Intermission begins.
May 1, 7.45 A.M., (Monday)	Short Intermission ends.
May 22, 8.00 A. M., (Monday)	Senior Examinations begin.
May 25, 8.00 A.M., (Thursday)	Other Examinations begin.
May 30, (Tuesday)	Memorial Day (half holiday).
June 1, 5.00 P. M., (Thursday)	Examinations end.
June 3, (Saturday)	Alumni Day.
June 4, (Sunday)	Baccalaureate Sunday.
June 5, (Monday)	Class Day.
June 6, (Tuesday)	University Day.
June 7, (Wednesday)	Summer Term begins.
June 7, 8, 9, 10, (Wednesday, Thursday, Friday, Saturday)	Examinations for Admission.

1916	1916–1917
Sept. 15, 16, 18, 19, (Friday, Saturday, Monday, Tuesday)	Examinations for Admission.
Sept. 20, 3.30 P.M., (Wednesday)	First Term begins.
Oct. 7, (Saturday)	Founder's Day.
Nov. 29, 12.00 M., (Wednesday)	Thanksgiving Recess begins.
Dec. 4, 7.45 A.M., (Monday)	Thanksgiving Recess ends.
Dec. 22, 12.00 M., (Friday)	Christmas Holidays begin.
1917	
Jan. 3, 7.45 A.M., (Wednesday)	Christmas Holidays end.
Jan. 26, 8.00 A.M., (Friday)	Examinations begin.
Feb. 2, 5.00 P.M., (Friday)	Examinations end.
Feb. 5, 7.45 A.M., (Monday)	Second Term begins.
Feb. 22, (Thursday)	Washington's Birthday Cele-
April 4, 12.00 M., (Wednesday)	Easter Holidays begin. [bration.
April 10, 7.45 A.M., (Tuesday)	Easter Holidays end.
April 26, 5.00 P.M., (Thursday)	Short Intermission begins.
April 30, 7.45 A.M., (Monday)	Short Intermission ends.
May 28, 8.00 A. M., (Monday)	Senior Examinations begin.
May 30, (Wednesday)	Memorial Day (half holiday).
May 31, 8.00 A.M., (Thursday)	Other Examinations begin.
June 7, 5.00 P.M., (Thursday)	Examinations end.
June 9, (Saturday)	Alumni Day.
June 10, (Sunday)	Baccalaureate Sunday.
June 11, (Monday)	Class Day.
June 12, (Tuesday)	University Day.
June 13, (Wednesday)	Summer Term begins.
June 13, 14, 15, 16, (Wednesday, Thursday, Friday, Saturday)	Examinations for Admission.

BOARD OF TRUSTEES

Henry R. Price,	Brooklyn, N. Y.
Rt. Rev. Ethelbert Talbot,	South Bethlehem.
Rembrandt Peale,	New York, N. Y.
Warren A. Wilbur,	South Bethlehem.
Charles L. Taylor,	Pittsburgh.
Albert N. Cleaver,	South Bethlehem.
Charles M. Schwab,	South Bethlehem.
David J. Pearsall,	Mauch Chunk.
Samuel D. Warriner,	Philadelphia.
Eugene G. Grace,	Bethlehem.

HONORARY TRUSTEE

Rev. Marcus A. Tolman,	Bethlehem.

HONORARY ALUMNI TRUSTEES

	Term Expires	
Franklin Baker, jr., Class of 1895.	1916,	Philadelphia.
Alfred E. Forstall, Class of 1883.	1917,	New York, N. Y.
Schuyler B. Knox, Class of 1893.	1918,	New York, N. Y.
Francis R. Dravo, Class of 1887.	1919,	Pittsburgh.

OFFICERS OF THE BOARD OF TRUSTEES

President,
HENRY R. PRICE.

Secretary,
WARREN A. WILBUR.

Treasurer,
E. P. WILBUR TRUST CO.,
South Bethlehem, Pa.

Assistant Secretary and Treasurer,
*H. SHELDON KITCHEL.

EXECUTIVE COMMITTEE

WARREN A. WILBUR, *Chairman.*

CHARLES L. TAYLOR, HENRY R. PRICE,
RT. REV. ETHELBERT TALBOT, CHARLES M. SCHWAB,
ALBERT N. CLEAVER.

COMMITTEE ON BUILDINGS AND GROUNDS

WARREN A. WILBUR, *Chairman.*

ALBERT N. CLEAVER, REMBRANDT PEALE,
DAVID J. PEARSALL.

COMMITTEE ON FINANCE AND INVESTMENTS

CHARLES L. TAYLOR, *Chairman.*

WARREN A. WILBUR, CHARLES M. SCHWAB.

* Died October 12, 1915.

FACULTY

HENRY S. DRINKER, E.M., LL.D.,
PRESIDENT,
University Park, South Bethlehem.

NATT M. EMERY, M.A.,
VICE-PRESIDENT,
38 South Center Street, Bethlehem.

JOSEPH F. KLEIN, D.E.,
DEAN OF THE FACULTY,
Professor of Mechanical Engineering.
357 East Market Street, Bethlehem.

CHARLES L. THORNBURG, C.E., PH.D.,
SECRETARY OF THE FACULTY,
Professor of Mathematics and Astronomy.
University Park, South Bethlehem.

WILLIAM C. THAYER, M.A., L.H.D.,
Professor of the English Language and Literature.
59 Market Street, Bethlehem.

JOHN L. STEWART, A.B., PH.B.,
Professor of Economics and History.
678 Ostrum Street, South Bethlehem.

ROBERT W. BLAKE, M.A.,
Professor of the Latin Language and Literature.
St. Luke's Place and Ostrum Street, South Bethlehem.

CHARLES J. GOODWIN, A.M., PH.D.,
Professor of the Greek Language and Literature.
118 Church Street, Bethlehem.

WILLIAM ESTY, S.B., M.A.,
Professor of Electrical Engineering.
318 East Market Street, Bethlehem.

JOSEPH W. RICHARDS, M.A., A.C., M.S., PH.D.,
Professor of Metallurgy.
University Park, South Bethlehem.

HOWARD ECKFELDT, B.S., E.M.,
Professor of Mining Engineering.
438 Seneca Street, South Bethlehem.

ARTHUR E. MEAKER, C.E.,
Emeritus Professor of Mathematics.
R. D. 2, Binghamton, N. Y.

PRESTON A. LAMBERT, M.A.,
Professor of Mathematics.
215 South Center Street, Bethlehem.

PHILIP M. PALMER, A.B.,
Professor of German.
University Park, South Bethlehem.

BENJAMIN LEROY MILLER, PH.D.,
Professor of Geology.
221 East Market Street, Bethlehem.
Absent on leave, first term.

FRANK P. McKIBBEN, S.B.,
Professor of Civil Engineering.
817 St. Luke's Place, South Bethlehem.

WINTER LINCOLN WILSON, C.E., M.S.,
Professor of Railroad Engineering.
360 East Market Street, Bethlehem.

PAUL BERNARD DE SCHWEINITZ, M.E.,
Professor of Machine Design.
313 Church Street, Bethlehem.

ROBERT W. HALL, A.M., PH.D.,
Professor of Biology and Lecturer on Forestry.
133 Church Street, Bethlehem.

PERCY HUGHES, A.B., A.M., PH.D.,
Professor of Philosophy and Education.
460 Birch Street, South Bethlehem.

CHARLES SHATTUCK FOX, PH.D.,
Professor of Romance Languages.
330 Wall Street, Bethlehem.

HOWARD R. REITER, M.A.,
Professor of Physical Education.
727 Seneca Street, South Bethlehem.

HARRY M. ULLMANN, A.B., PH.D.,
Professor of Chemistry.
69 Church Street, Bethlehem.

JOHN HUTCHESON OGBURN, C.E.,
Professor of Mathematics and Astronomy.
318 Fourth Avenue, Bethlehem.

BARRY MACNUTT, E.E., M.S.,
Professor of Physics.
928 Ostrum Street, South Bethlehem.

ARTHUR WARNER KLEIN, M.E.,
Professor of Mechanical Engineering.
224 South High Street, Bethlehem.

VAHAN S. BABASINIAN, A.M., PH.D.,
Associate Professor of Organic Chemistry.
430 Cherokee Street, South Bethlehem.

STANLEY S. SEYFERT, E.E., M.S.,
Associate Professor of Electrical Engineering.
456 Chestnut Street, South Bethlehem.

RALPH J. FOGG, S.B.,
Associate Professor of Civil Engineering.
723 Cherokee Street, South Bethlehem.

LECTURERS

EDWARD H. WILLIAMS, JR., B.A., E.M., A.C., F.G.S.A.,
Lecturer on Mining and Geology.
Woodstock, Vt.

WILLIAM L. ESTES, A.M., M.D.,
Lecturer on Physiology and Hygiene.
805 Delaware Avenue, South Bethlehem.

ASSISTANT PROFESSORS

MYRON J. LUCH, B.A., M.A., PH.D.,
Assistant Professor of English.
118 Second Avenue, Bethlehem.

JOHN E. STOCKER, B.S., M.S.,
Assistant Professor of Mathematics and Astronomy.
220 North Linden Street, Bethlehem.

JAMES HUNTER WILY, E.E.,
Assistant Professor of Physics.
1007 Delaware Avenue, South Bethlehem.

CHARLES K. MESCHTER, B.S., B.A., M.A., PH.D.,
Assistant Professor of English.
27 North New Street, Bethlehem.

GAR A. ROUSH, A.B., M.S.,
Assistant Professor of Metallurgy.
311 Cherokee Street, South Bethlehem.

ALPHA A. DIEFENDERFER, A.C., M.S.,
Assistant Professor of Assaying and Quantitative Analysis.
636 West Broad Street, Bethlehem.

SAMUEL H. SALISBURY, JR., B.S., M.S.,
Assistant Professor of Industrial Chemistry.
411 Cherokee Street, South Bethlehem.

GEORGE C. BECK, A.C.,
Assistant Professor of Quantitative Analysis.
411 Cherokee Street, South Bethlehem.

SYLVANUS A. BECKER, C.E., M.S.,
Assistant Professor of Civil Engineering.
103 North Street, Bethlehem.

JOSEPH B. REYNOLDS, B.A., M.A.,
Assistant Professor of Mathematics and Astronomy.
632 West Broad Street, Bethlehem.

ROLLIN L. CHARLES, B.A., M.A.,
Assistant Professor of Physics.
744 Seneca Street, South Bethlehem.

THOMAS EDWARD BUTTERFIELD, M.E., C.E.,
Assistant Professor of Mechanical Engineering.
672 Ostrum Street, South Bethlehem.

FRED VIALL LARKIN, B.S., M.E.,
Assistant Professor of Mechanical Engineering.
108 North Maple Street, Bethlehem.
Absent on leave.

FERDINAND FRIIS HINTZE, A.B., A.M., PH.D.,
Assistant Professor of Geology.
540 Chestnut Street, South Bethlehem.

SAMUEL R. SCHEALER, E.E.,
Assistant Professor of Electrical Engineering.
1535 West Broad Street, Bethlehem.

INSTRUCTORS

EMIL GELHAAR,
Instructor in Freehand Drawing.
148 South Main Street, Bethlehem.

KEARNEY E. HENDRICKS, S.B.,
Instructor in Civil Engineering.
451 Chestnut Street, South Bethlehem.
Absent on leave.

J. HUNT WILSON, PH.D.,
Instructor in Physical Chemistry.
531 Cattell Street, Easton.

HOWARD M. FRY, E.E., M.S.,
Instructor in Physics.
319 Seventh Avenue, Bethlehem.

CHARLES H. MAGUIRE, B.S.,
Instructor in Chemistry.
143 Wall Street, Bethlehem.

RAYMOND W. WALTERS, B.A., M.A.,
Instructor in English.
431 East North Street, Bethlehem.

HERMAN P. SMITH, E.M.,
Instructor in Mining Engineering.
North Fourth Avenue, Bethlehem.

RALPH L. BARTLETT, S.B.,
Instructor in Mining Engineering.
734 Cherokee Street, South Bethlehem.

MERTON O. FULLER, C.E.,
Instructor in Civil Engineering.
624 Fiot Avenue, South Bethlehem.

PARKE B. FRAIM, E.M.,
Instructor in Physics.
Section E, Taylor Hall, South Bethlehem.

GEORGE FREDERICK ALRICH, B.S., M.S.,
Instructor in Mathematics.
213 East Madison Street, Easton.

ROBERT LYLE SPENCER, B.M.E.,
Instructor in Mechanical Engineering.
412 East Broad Street, Bethlehem.

THEOPHIL H. MUELLER, A.B., B.D., M.A.,
Instructor in German.
35 East Broad Street, Bethlehem.

STANLEY J. THOMAS, B.S., M.S., M.A.,
Instructor in Biology.
144 Wall Street, Bethlehem.

JOHN MILTON TOOHY, B.A.,
Instructor in Romance Languages,
419 Cherokee Street, South Bethlehem.

WALLACE G. MATTESON, B.S., E.M., El.Met.,
Instructor in Geology.
502 Brodhead Avenue, South Bethlehem.

MORRIS S. KNEBELMAN, B.S., M.S.,
Instructor in Mathematics.
214 North Jordan Street, Allentown.

JAMES B. ARTHUR,
Instructor in Electrical Engineering.
Absent on leave.

GEORGE JANTZEN BUCHNER, B.S.,
Instructor in Physics.
315 Cherokee Street, South Bethlehem.

HOWARD DIETRICH GRUBER, E.E.,
Instructor in Electrical Engineering.
486 Birkel Avenue, South Bethlehem.

ROBERT L. FOX, C.E.,
Instructor in Civil Engineering.
87 East Broad Street, Bethlehem.

G. E. M. JAUNCEY, B.S.,
Instructor in Physics.
131 Wall Street, Bethlehem.

JOSEPH S. IRWIN, B.S.,
Instructor in Geology.
488 Birkel Avenue, South Bethlehem.

EZRA BOWEN, IV, B.S.,
Instructor in Economics.
Brodhead Avenue & Eighth Street, South Bethlehem.

JOHN LAMBERT CONNER, E.E.,
Instructor in Electrical Engineering.
516 Pawnee Street, South Bethlehem.

JAMES C. ASHBY, A.B.,
Instructor in Chemistry.
453 Chestnut Street, South Bethlehem.

ARTHUR S. CALLEN, EL.MET.,
Instructor in Metallurgy.
453 Chestnut Street, South Bethlehem.

JAMES S. LONG, CH.E., M.S.,
Instructor in Chemistry.
Section A, Taylor Hall, South Bethlehem.

ROBERT LEE RHOADS, B.S.,
Instructor in Mechanical Engineering.
488 Birkel Avenue, South Bethlehem.

STEWARD CHANDLER, PH.B.,
Instructor in French.
454 Chestnut Street, South Bethlehem.

JOHN H. BICKLEY, B.S.,
Instructor in Accounting.
427 Cherokee Street, South Bethlehem.

PETER HOEKSTRA, B.A., M.A., PH.D.,
Instructor in History.
427 Cherokee Street, South Bethlehem.

WILLIAM E. LEWIS, A.B., CH.E.,
Instructor in Chemistry.
27 North 15th Street, Allentown.

WILLIAM H. STERNER, C.E.,
Instructor in Mathematics.
518 Pawnee Street, South Bethlehem.

EDWARD C. ROEST, M.A.,
Instructor in German.
413 Wall Street, Bethlehem.

FRED O. NOETZLI, C.E., DR.SC.,
Instructor in Civil Engineering.
427 Cherokee Street, South Bethlehem.

FRANK P. CASSIDY,
Assistant in Physical Education.
657 Locust Street, South Bethlehem.

WILLIAM L. ESTES, A.M., M.D.,
Consulting Physician and Surgeon,
805 Delaware Avenue, South Bethlehem.

WILLIAM L. ESTES, JR., B.A., M.D.,
Assistant Consulting Physician and Surgeon and Supervising Physician and Surgeon of the Department of Physical Education and Athletics.
819 St. Luke's Place, South Bethlehem.

CONFERENCE DEPARTMENT

Director,
PRESTON A. LAMBERT, M.A.
Mathematics, PROFESSOR LAMBERT.
Modern Languages, PROFESSOR PALMER.
Physics, ASSISTANT PROFESSOR CHARLES.
Chemistry, MR. MAGUIRE.

ADMINISTRATIVE OFFICERS

HENRY S. DRINKER, *President.*
NATT M. EMERY, *Vice-President.*
JOSEPH F. KLEIN, *Dean of the Faculty.*
CHARLES L. THORNBURG, *Secretary of the Faculty.*
JOHN L. STEWART, *Director of the Library.*
FREDERICK R. ASHBAUGH, *Bursar.*
RAYMOND W. WALTERS, *Registrar.*

OTHER OFFICERS

J. CLARENCE CRANMER, *Supt. of Buildings and Grounds.*
JOHN D. HARTIGAN, *Master Mechanic.*
GEORGE B. MATTHEWS, *Steward of the College Commons and in charge of Dormitories and Drown Memorial Hall.*

COMMITTEE ON ADMISSION

PROFESSORS THORNBURG, THAYER, STEWART, BLAKE, GOODWIN, PALMER, FOX.

LIBRARY

Director,
JOHN L. STEWART, A.B., PH.B.,
Assistant Librarian,
PETER F. STAUFFER,
519 Wyandotte Street, South Bethlehem.

PACKER MEMORIAL CHURCH

Chaplain,
REV. BRAYTON BYRON, B.D.,
321 Wyandotte Street, South Bethlehem.
Organist,
T. EDGAR SHIELDS,
56 Church Street, Bethlehem.

LEHIGH UNIVERSITY

ORIGIN

The Hon. Asa Packer, of Mauch Chunk, during the year 1865, appropriated the sum of $500,000, to which he added one hundred and fifteen acres of land in South Bethlehem, to establish an educational institution in the Lehigh Valley. On this foundation rose Lehigh University, incorporated by the Legislature of Pennsylvania by act approved February 9, 1866. In addition to these gifts, made during his lifetime, Judge Packer by his last will gave to the University and its Library an endowment of $2,000,000.

DESIGN

The original object of Judge Packer was to afford the young men of the Lehigh Valley a complete education, technical, literary and scientific, for those professions represented in the development of the peculiar resourses of the surrounding region. In furtherance of this purpose the University offers the following four-year courses:

1. The Courses in Arts and Science.
2. The Course in Civil Engineering.
3. The Course in Mechanical Engineering.
4. The Course in Metallurgical Engineering.
5. The Course in Electrometallurgy.
6. The Course in Mining Engineering.
7. The Course in Electrical Engineering.
8. The Course in Chemistry.
9. The Course in Chemical Engineering.

These courses are described in detail on pages 30 to 74.

REQUIREMENTS FOR ADMISSION

Candidates for admission to Lehigh University must be at least sixteen years of age, must present testimonials of good moral character, and must be qualified in the entrance subjects as enumerated below.

THE COURSES IN ARTS AND SCIENCE

Candidates for admission to these Courses must present entrance requirements as follows:*

A. FOR THE COURSE LEADING TO THE DEGREE OF BACHELOR OF ARTS

	Units
English,	3
Latin,	4
Greek,	3
or German A or French A,	2 | 3
or Elective,	1
Ancient History,	1
History (Modern, English, or American),	1
Elementary Algebra,	1½
Plane Geometry,	1
	14½

Students who offer German, or French, and an Elective for admission, but, having had no opportunity to prepare in Greek, desire to take up that study in the University, are at present permitted to substitute beginners' Greek for the regular Greek of the Freshman year. They then pursue the study of Greek for at least three years.

*A "unit" is the equivalent of at least five exercises a week for one school year. Detailed information concerning these subjects is given on pages 19 to 26.

B. FOR THE COURSES LEADING TO THE DEGREE OF BACHELOR OF SCIENCE

(a) All candidates must present the following subjects:

	Units
English,	3
German A or French A,	2
History (Ancient, Modern, English or American,)	1
Elementary Algebra,	1½
Plane Geometry,	1
	8½

(b) Candidates must present besides the subjects in (a), 5½ units from the following:

	Units
Advanced Algebra,	½
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
Latin,	2, 3 or 4
French A or German A or Spanish A,	2
American History,	1
Ancient History,	1
Modern History,	1
English History,	1
Freehand Drawing,	½
Mechanical Drawing,	½
Physics,	1
Elementary Chemistry,	1
Zoölogy,	½ or 1
Botany,	½ or 1
Physiology and Hygiene,	½ or 1
Physiography,	½ or 1
Manual Training,	½ or 1

Candidates for admission to the Course in Business Administration may present Bookkeeping, Stenography and Typewriting to count ½ or 1 unit.

Detailed information concerning these subjects is given on pages 19 to 26.

Graduates of High Schools who are unable to present German or French as specified under 1, but who can offer four units in Latin, in keeping with the official curriculum of the High Schools of the State, may substitute the two additional units of Latin for French or German.

THE COURSES IN TECHNOLOGY

(a) Candidates for admission to the Courses in Civil Engineering, Mechanical Engineering, Metallurgical Engineering, Electrometallurgy, Mining Engineering, Electrical Engineering, Chemistry, and Chemical Engineering must present the following subjects:

	Units
English,	3
German A or French A,	2
History (Ancient, Modern, English or American,)	1
Elementary Algebra,	1½
Plane Geometry,	1
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
	9½

(b) Candidates must present besides the subjects in (a), 4½ units from the following:

	Units
Latin,	2, 3 or 4
Greek,	2 or 3
German,	2 or 3
French,	2 or 3
Spanish,	2 or 3
American History,	1
Ancient History,	1
Modern History,	1
English History,	1
Freehand Drawing,	½
Mechanical Drawing,	½
Physics,	1
Elementary Chemistry,	1
Zoölogy,	½ or 1
Botany,	½ or 1
Physiology and Hygiene,	½ or 1
Physiography,	½ or 1
Manual Training,	½ or 1

Detailed information concerning these subjects is given on pages 19 to 26.

The detailed requirements in the various subjects are as follows:

ENGLISH

Preparation in English has two main objects: (a) command of correct and clear English, spoken and written; (b) ability to read with accuracy, intelligence and appreciation.

ENGLISH GRAMMAR AND COMPOSITION. The first object requires instruction in grammar and composition. English grammar should ordinarily be reviewed in the secondary school; and correct spelling and grammatical accuracy should be rigorously exacted in connection with all written work during the four years. The principles of English composition governing punctuation, the use of words, paragraphs, and the different kinds of composition, including letter writing, should be thoroughly mastered; and practice in composition, oral as well as written, should extend throughout the secondary school period. Written exercises may well comprise narration, description, and easy exposition and argument based upon the principles of elementary rhetoric, as given in any approved High School Rhetoric. It is advisable that subjects for this work be taken from the student's personal experience, general knowledge, and studies other than English, as well as from his reading in literature. Finally, special instruction in language and composition should be accompanied by concerted efforts of teachers in all branches to cultivate in the student the habit of using good English in his recitations and various exercises, whether oral or written.

LITERATURE. The second object is sought by means of two lists of books, headed respectively *reading* and *study;* from which may be framed a progressive course in literature covering four years. In connection with both lists, the student should be trained in reading aloud and be encouraged to commit to memory some of the more notable passages both in verse and in prose. As an aid to literary appreciation, he is further advised to acquaint himself with the most important facts in the lives of the authors whose works he reads and with their place in literary history.

The books for reading and study are to be selected from the groups suggested by the Conference on Uniform Entrance Requirements in English. 3 units.

HISTORY

The requirement in History is based on the recommendation of the Committee of Seven of the American Historical Association.

ANCIENT HISTORY, with special reference to Greek and Roman History, and including also a short introductory study of the more ancient nations and the chief events of the early Middle Ages, down to the death of Charlemagne (814.) 1 unit.

MEDIAEVAL AND MODERN EUROPEAN HISTORY, from the death of Charlemagne to the present time. 1 unit.

ENGLISH HISTORY. With due reference to social and political development. 1 unit.

AMERICAN HISTORY AND CIVIL GOVERNMENT. With due reference to social and political development. 1 unit.

The examinations in history will be so framed as to require comparison and the use of judgment on the pupil's part rather than the mere use of memory. The examinations will presuppose the use of good text-books, collateral reading, and practice in written work. Geographical knowledge will be tested by requiring the location of places and movements on an outline map. 1 unit.

MATHEMATICS

ELEMENTARY ALGEBRA, ALGEBRA TO QUADRATICS. The four fundamental operations for rational algebraic expressions. Factoring, determination of highest common factor and lowest common multiple by factoring. Fractions, including complex fractions, and ratio and proportion. Linear equations, both numerical and literal, containing one or more unknown quantities. Problems depending on linear equations. Radicals, including the extraction of the square root of polynomials and of numbers. Exponents, including the fractional and negative. 1 unit.

ELEMENTARY ALGEBRA, QUADRATICS AND BEYOND. Quadratic equations, both numerical and literal. Simple cases of equations with one or more unknown quantities, that can be solved by the methods of linear or quadratic equations. Problems depending on quadratic equations. The binomial theorem for positive integral exponents. The formulas for the nth term and the sum of the terms of arithmetic and geometric progressions, with applications. ½ unit.

ADVANCED ALGEBRA. Permutations and combinations, limited to simple cases. Complex numbers, with graphical representation of sums and differences. Determinants, chiefly of the second, third, and fourth orders, including the use of minors and the solution of linear equations. Numerical equations of higher degree, and so much of the theory of equations, with graphical methods, as is necessary for their treatment, including Descartes's

rule of signs and Horner's method, but not Sturm's functions or multiple roots. ½ unit.

PLANE GEOMETRY. The usual theorems and constructions of good text-books, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas; regular polygons and the measurement of the circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of lines and plane surfaces. 1 unit.

SOLID GEOMETRY. The usual theorems and constructions of good text-books, including the relations of planes and lines in space; the properties and measurement of prisms, pyramids, cylinders, and cones; the sphere and the spherical triangle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of surfaces and solids. ½ unit.

PLANE TRIGONOMETRY. Definitions and relations of the six trigonometric functions as ratios; circular measurement of angles. Proofs of principal formulas, in particular for the sine, cosine, and tangent of the sum and the difference of two angles, of the double angle and the half angle, the product expressions for the sum or the difference of two sines or of two cosines, etc.; the transformation of trigonometric expressions by means of these formulas. Solution of trigonometric equations of a simple character. Theory and use of logarithms (without the introduction of work involving infinite series). The solution of right and oblique triangles and practical applications. Candidates must bring their logarithmic tables to the examination. ½ unit.

Candidates must have a knowledge of the metric system and be prepared to solve problems in either Algebra or Geometry involving the use of the metric system.

PHYSICS

The course of instruction in Physics should include:

(a) The study of some standard text-book, for the purpose of obtaining a connected view of the subject. (b) Instruction by lecture table demonstrations, to be used mainly for illustration of the facts and phenomena of physics. (c) Individual laboratory work consisting of at least thirty experiments.

The aim of laboratory work should be to supplement the pupil's fund of concrete knowledge and to cultivate his power of accurate observation and clearness of thought and expression. The exercises should be chosen with a view to furnishing forceful illus-

trations of fundamental principles and their practical applications. They should be such as yield results capable of ready interpretation, obviously in conformity with theory, and free from the disguise of unintelligible units. 1 unit.

MODERN LANGUAGES

ELEMENTARY GERMAN, A. This requirement follows, in the main, the recommendations of the Committee of Twelve of the Modern Language Association. It is expected that two whole years will be given to the work.

During the first year the work should comprise:

1. Careful drill in pronunciation.

2. The memorizing and frequent repetition of easy colloquial sentences.

3. Drill upon the rudiments of grammar; that is, upon the inflection of the articles, of such nouns as belong to the language of every-day life, of adjectives, pronouns, weak verbs, and the more usual strong verbs; also upon the use of the more common prepositions, the simpler uses of the modal auxiliaries, and the elementary rules of syntax and word-order.

4. Abundant easy exercises, designed not only to fix in mind the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression.

5. Reading of from 75 to 100 pages of graduated texts from a reader, with constant practice in translating into German easy variations upon sentences selected from the reading lesson (the teacher giving the English), and in the reproduction from memory of sentences previously read.

During the second year the work should comprise:

1. The reading of from 150 to 200 pages of literature in the form of easy stories and plays.

2. Accompanying practice, as before, in the translation into German of easy variations upon the matter read and also in the offhand reproduction, sometimes orally and sometimes in writing, of the substance of short and easy selected passages.

3. Continued drill in the rudiments of the grammar, directed to the ends of enabling the pupil, first, to use his knowledge with facility in the formation of sentences, and secondly, to state his knowledge correctly in the technical language of grammar.

2 units.

INTERMEDIATE GERMAN, B. This work should comprise, in addition to the elementary course, the reading of about 400 pages of moderately difficult prose and poetry, with constant practice in giving sometimes orally and sometimes in writing, paraphrases, abstracts, or reproductions from memory of selected portions of the matter read; also grammatical drill upon the less usual strong verbs, the use of articles, cases, auxiliaries of all kinds, tenses and modes (with special reference to the infinitive and the subjunctive), and likewise upon word order and word formation.

1 unit.

ELEMENTARY FRENCH, A. This requirement follows, in the main, the recommendations of the Committee of Twelve of the Modern Language Association. It is expected that two whole years will be given to the work.

During the first year the work should comprise:

1. Careful drill in pronunciation.
2. The rudiments of grammar, including the inflection of the regular and the more common irregular verbs, the plural nouns, the inflection of adjectives, participles, and pronouns; the use of personal pronouns, common adverbs, prepositions, and conjunctions; the order of words in the sentence, and the elementary rules of syntax.
3. Abundant easy exercises, designed not only to fix in the memory the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression.
4. The reading of from 100 to 175 pages of graduated texts, with constant practice in translating into French easy variations of the sentences read (the teacher giving the English), and in reproducing from memory sentences previously read.
5. Writing French from dictation.

During the second year the work should comprise:

1. The reading of from 250 to 400 pages of easy modern prose in the form of stories, plays, or historical or biographical sketches.
2. Constant practice, as in the previous year, in translating into French easy variations upon the texts read.
3. Frequent abstracts, sometimes oral and sometimes written, of portions of the text already read.
4. Writing French from dictation.
5. Continued drill upon the rudiments of grammar, with constant application in the construction of sentences.

6. Mastery of the forms and uses of pronouns, pronominal adjectives, of all but the rare irregular verb forms, and of the simpler uses of the conditional and subjunctive. 2 units.

INTERMEDIATE FRENCH, B. This should comprise the reading of from 400 to 600 pages of French of ordinary difficulty, a portion to be in the dramatic form; constant practice in giving French paraphrases, abstracts or reproductions from memory of selected portions of the matter read; the study of a grammar of moderate completeness; writing from dictation. 1 unit.

ELEMENTARY SPANISH, A. The completion of some elementary Spanish grammar together with the reading of not less than 300 pages of simple Spanish prose. 2 units.

INTERMEDIATE SPANISH, B. The reading of not less than 500 additional pages of Spanish prose together with the translation of at least 40 pages of simple connected English prose into Spanish. 1 unit.

LATIN

The following requirements in Latin are in accordance with the recommendations made by the Commission on College Entrance Requirements in Latin, October, 1909.

LATIN, A and B. First and Second Year Latin. Required of applicants for admission to the B.A. Course; elective for others. Grammar, Elementary Prose Composition. Reading of an amount not less than Cæsar, Gallic War, I-IV, selected by the schools from Cæsar (Gallic War and Civil War) and Nepos (Lives). 2 units.

LATIN, C. Third Year Latin. Required of applicants for admission to the B.A. Course; elective for others. Reading of an amount not less than Cicero, Orations against Catiline, For the Manilian Law, and For Archias, selected by the schools from Cicero (Orations, Letters, and De Senectute) and Sallust (Catiline and Jugurthine War). 1 unit.

LATIN, D. Fourth Year Latin. Required of applicants for admission to the B.A. Course. Reading of an amount not less than Vergil, Aeneid I-VI, selected by the schools from Vergil (Aeneid, Bucolics, and Georgics) and Ovid (Metamorphoses, Fasti, Tristia, Amores).

Students who offer Latin as an *elective* entrance subject, must present at least two units.

GREEK

The following requirements in Greek are selected in as close accordance as is practicable with the recommendations of the American Philological Association.

GREEK. Grammar; Elementary Prose Composition, consisting principally of detached sentences to test the candidate's knowledge of grammatical constructions; Xenophon: the first four books of the Anabasis; the translation, at sight, of a passage from some work of Xenophon. **2 units.**

GREEK. Homer's Iliad, I-III: The first three books of the Iliad (omitting II, 494-end), and the Homeric forms, constructions, and prosody. **1 unit.**

Students who offer Greek as an *elective* entrance subject, must present at least two units.

CHEMISTRY

The requirement in Chemistry is based on the report of the Committee on Chemistry of the Science Department of the National Educational Association.

ELEMENTARY CHEMISTRY. It is recommended that the candidate's preparation in chemistry include: (a) Individual laboratory work, comprising at least forty exercises. (b) Instruction by lecture table demonstrations, to be used mainly as a basis for questioning upon the general principles involved in the pupil's laboratory investigations. (c) The study of at least one standard text-book, to the end that the pupil may gain a comprehensive and connected view of the most important facts and laws of elementary chemistry. **1 unit.**

Students, properly qualified, will be examined in Elementary Chemistry on the first Saturday of the term; those passing the examination will be privileged to omit Chemistry (390) and Chemical Laboratory (391), and will, instead, take Theoretical Chemistry (392) during the first term.

DRAWING

FREEHAND DRAWING. Sketching of simple geometrical figures, of objects, and from copy. At least twenty plates must be submitted. **½ unit.**

MECHANICAL DRAWING. The use of instruments and the preparation of at least twenty plates, illustrating the elements of descriptive geometry or simple machine parts. **½ unit.**

PHYSIOGRAPHY

PHYSIOGRAPHY. The study of one of the leading secondary text-books in physical geography, that a knowledge may be gained of the essential principles, and of well selected facts illustrating those principles. Individual laboratory work, comprising at least forty exercises with notebook, is recommended. ½ or 1 unit.

BOTANY

BOTANY. An amount equal to that contained in Bergen's "Foundations of Botany" with laboratory work. ½ or 1 unit.

PHYSIOLOGY AND HYGIENE

PHYSIOLOGY AND HYGIENE. A course covering, approximately, what is given in such a text-book as Huxley & Youman's "Physiology and Hygiene." ½ or 1 unit.

ZOÖLOGY

ZOÖLOGY. The equivalent of Jordan, Kellogg & Heath's "Animal Studies" with laboratory work. ½ or 1 unit.

MANUAL TRAINING

MANUAL TRAINING. Shop work in wood or metal in schools giving courses in manual training. ½ or 1 unit.

BOOKKEEPING, TYPEWRITING AND STENOGRAPHY

BOOKKEEPING, TYPEWRITING, AND STENOGRAPHY. Covering a formal course of study at school. ½ or 1 unit.

DATES OF EXAMINATIONS

Examinations for admission to the University will be held in 1916, on Wednesday, Thursday, Friday, and Saturday, June 7, 8, 9, and 10, and on Friday, Saturday, Monday, and Tuesday, September 15, 16, 18, and 19. In 1917, on June 13, 14, 15, and 16, and September 14, 15, 17, and 18.

The examinations are held in June and September in the following order:

First Day.—Geometry, 8 A.M.; Physics, Ancient History, 2 P.M.

Second Day.—Elementary Algebra, 8 A.M.; Trigonometry, 2 P.M.

Third Day.—Latin, 8 A.M.; German, French, Greek, 2 P.M.

Fourth Day.—English, 8 A.M.; History, 2 P.M.

Examinations in subjects presented for elective units may be arranged by correspondence with the Registrar.

Candidates for admission wishing to obtain credit for any subject of the first term of the Freshman year should notify the Registrar before September 1.

Certificates of the College Entrance Examination Board are accepted in lieu of the entrance examinations held at the University in those subjects in which the recorded grade is C (60 per cent.) or over.

DIVISION OF EXAMINATIONS FOR ADMISSION

Candidates for admission to the Freshman Class may pass all the examinations in June, or all in September, or some in June and the rest in September of the year of entrance, or may take them in two consecutive years. In the last case, for any course candidates may present themselves for examination in the first year in the following subjects: Plane Geometry, English, and History. In addition, candidates for the B. A. course in Arts and Science may present themselves for examination in the first year in Latin Grammar, Cæsar, Cicero; and one of the following: (*a*) Greek Grammar and three books of Anabasis; (*b*) German; (*c*) French.

Candidates intending to enter the University in September are advised to present themselves for examination in June; if they are not fully prepared at that time they will receive credit for the examinations then satisfactorily passed.

ADMISSION TO ADVANCED STANDING

Candidates for admission to advanced studies in any course are required to pass, *in addition to the entrance examinations for that course*, examinations in the work already done by the classes which they desire to enter. These examinations are held in September on the same days as those for entrance to the Freshman Class. The additional subjects may be found in the schedule of studies of the different departments.

A student from another college or university is admitted without entrance examinations, provided he has covered the entrance subjects required at this University and has attended another college or university for one or more complete terms. Evidence to that effect should first be filed with the Registrar. If a student has been dropped from another college or university, he must present his record to the Committee on Standing of Students and

his admission will largely depend upon the record he made in the institution from which he was dropped.

Applicants who have obtained a certificate that the entrance requirements of the University are satisfied and who desire to enter the University are advised to report personally to the Secretary of the Faculty. The Secretary of the Faculty will issue to the applicant a paper authorizing him to confer with the professors regarding the subjects already taken by the class he desires to enter. It is necessary for an applicant to bring a certificate naming the subjects completed at another college, together with a copy of the catalogue or register of the college; and it is desirable for him to bring his drawings, field notes, computations and laboratory note-books for inspection, and personal certificates from his teachers showing the grades attained at the college from which he comes. In case it is inconvenient for the applicant to report in person, he may send the credentials here mentioned by mail or express to the Secretary of the Faculty, who will place them before the professors and communicate the result to the applicant. Professors may admit the student to advanced standing if satisfied with these evidences of proficiency, or they may find it necessary to give a formal examination in the subjects for which he desires credits.

Professors will note their conclusions on the paper furnished the applicant, who must return the same to the Secretary of the Faculty within the time specified on its face. If all the subjects are accepted the applicant will be admitted in full standing to the Freshman, Sophomore, or Junior Class, as the case may be. If nearly all are accepted, the candidate may be admitted with conditions, and the Secretary of the Faculty will inform him of the rules applicable to conditioned students.

Graduates of other colleges having the Bachelor's degree or its equivalent are similarly admitted to advanced standing. The length of time necessary for the completion of a course will depend entirely upon the student's attainments at entrance and his ability. Every opportunity will be given for the completion of a course in the minimum time possible.

It is desirable that a student who anticipates taking a technical course at Lehigh University after graduation from college should so arrange his work in college as to cover as many as possible of the subjects of the Freshman and Sophomore years of the technical course he intends to enter.

ADMISSION TO GRADUATE COURSES

Students of this University who have taken their first degree, and others, on presenting a diploma of an equivalent degree conferred elsewhere, are admitted to advanced studies, according to the plan to be found on page 117 under the general subject of Graduate Courses.

PREPARATORY SCHOOL CERTIFICATES

The University has no permanent arrangement with any preparatory school whereby certificates are accepted in lieu of entrance examinations.

Those who desire to enter on certificate must request their preparatory school principals to send to the Registrar as soon as the school closes in June a complete record of their preparatory school work. Blanks for this purpose will be furnished by the University.

The certificate will be submitted to the professors in charge of the entrance subjects and if the work has been pursued and completed in a manner and within a time limit satisfactory to the professors concerned the certificate will be accepted in the subjects which it covers.

EXAMINATIONS AT SCHOOLS

When desired by the principals, arrangements will be made to hold at the schools the June examinations for admission to the University. Such requests should be made before June 1.

COURSES IN ARTS AND SCIENCE

A. COURSE LEADING TO THE DEGREE OF BACHELOR OF ARTS

This course is planned to meet the requirements of a liberal education, and to lay the foundation for the study of the several professions and for the intelligent following of business and industrial pursuits. The University desires that the work of this course be not merely academic in character, but of practical worth, and that it sustain a direct relation to the needs of the life and profession which each student has in view. The studies are to a great extent elective, but in order that the culture purpose which is the basis of the plan of study may not be ignored, a limited amount of work in subjects of a literary, philosophic, and scientific character, which are both accepted instruments of culture and necessary preliminaries of all higher study, is required of each student. The required work includes courses in the English, German, French, Latin, and Greek languages and literatures, in mathematics, physics, chemistry, biology, geology, history, business law, economics, psychology, and philosophy. Beyond this the work is elective. During the Freshman year the studies are prescribed; from then on they become increasingly subject to the student's own choice.

In pursuance of the policy of making this course practical and directly preparatory to each student's life-work, large freedom is allowed in the choice of electives. Any study which is taught in the University may be taken, subject to the qualification and purpose of the student. Students are counseled to select their work systematically with reference to some definite end. In this they receive the assistance and coöperation of the Faculty, under the oversight of one of whose members each student arranges his course. Endeavor is made to treat students individually rather than in groups, and to suit the work of each to his needs and qualifications. Instruction is given by lectures, by recitations, by the assignment of readings and topics for special study and dissertations, and when the subject admits of it, by practical work in field or laboratory. Field work or laboratory work accompanies courses in surveying, geology, physics, chemistry, astronomy, biology, psychology, and allied subjects; and the classes of the evening school conducted by the Department of Education give opportunity for practice in teaching.

ADMISSION, LENGTH OF COURSE, DEGREE

The requirements for admission are stated in detail on page 16.

Students who enter on Greek must continue the study of Greek throughout the Freshman year; and those who, having had no opportunity to prepare in Greek, desire to begin the study of Greek in college (see page 16) may take it up in the Freshman or Sophomore year and pursue it for at least three years.

The course of study extends over four years. Students, however, who can do so, are permitted to pass off required work in advance and to fill up the time thus left free with other advanced studies, with a view to completing the requirements for graduation in a shorter time.

The degree of Bachelor of Arts is conferred upon graduates of this course.

PREPARATION FOR LAW, MEDICINE. TEACHING, ETC.

Young men who have in view the professions of law, medicine, theology, teaching, or journalism, will find in the curriculum of the Bachelor of Arts course that general and special preliminary training which is more and more becoming essential. For the better preparation of such men for entrance upon their professional studies the University is constantly enlarging its curriculum as need determines. Laboratory work accompanies the courses in psychology, an evening school is conducted in which students of Education may practice teaching, and the fine equipment of Williams Hall furnishes superior facilities for the teaching of biology and zoölogy, and for practical courses in bacteriology. The opportunities which the biological, chemical and physical laboratories of the University afford for preliminary medical studies, and for preparation to teach these sciences are unsurpassed.

COMBINATION OF LITERARY AND TECHNICAL STUDIES

The desirability of a liberal training for an engineer has led the University to offer courses in which, by combining the studies of the several technical departments with the work of the course in Arts and Science, a student may gain both a literary and a professional education, with the corresponding degree, in six years. These courses possess decided advantages over the usual engineering curriculum of four years, the studies of which are necessarily almost wholly technical, and the value of the wider training for which they provide far outweighs the extra expenditure of time. The outline in full of a combined course leading to the degrees of B.A. and C.E. is printed on pages 44 and 45.

SCHEDULE OF STUDIES OF THE B.A. COURSE

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Latin, (4)	40	Latin, (5)	41, 42
English, (3)	120, 121, 125	English, (2)	122, 125
Plane Trigonometry, (3)	141	Solid Geometry, (2)	140
Greek, (4)	50	Spherical Trig., (1)	142
or { Chemistry, (2)	390	Greek, (4)	51
{ Chemical Lab., (2)	391	*or* { Qual. Analysis, (3)	393
German, (3)	90 *or* 96	{ Stoichiometry, (1)	394
or French, (3)	80 *or* 82	German, (3)	91 *or* 97
Gymnasium, (2)	440	*or* French, (3)	81 *or* 83
		Gymnasium, (2)	440

Students who enter with Greek are not required to present German or French for entrance, and therefore they may begin German in the Freshman year.

Students who begin Greek in the Freshman year continue it through the Junior year. Such men present either German or French for admission and therefore take advanced German or French in the Freshman year.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
English, (2)	123, 126	English, (2)	124, 126
German, (3)	96 *or* 98	German, (3)	97 *or* 98
or French, (3)	84	*or* French, (3)	85
Physics, (3)	324	*or* Elem. Mech., (5)	321, 321a
or Elem. Mechanics, (2)	320	*or* Elem. Mechanics, (5)	321
History, (3)	35	History, (3)	34
Electives, (6)		Electives, (6)	
or (7)	see page 33	*or* (4)	see page 33
Physical Education, (1)	442	Physical Education, (1)	442

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Psychology, (2)	1	Psychology, (2)	2
Economics, (3)	16	Economics, (3)	17
French, (3)	70, 82 *or* 86	French, (3)	71, 83 *or* 86
or German, (3)	90	*or* German, (3)	91
Biology, (3)	292	General Geology, (2)	270
Electives, (6)	see page 33	Geological Lab., (1)	271
Physical Education, (1)	442	Electives, (6)	see page 33
		Physical Education, (1)	442

SENIOR YEAR

FIRST TERM		SECOND TERM	
History of Philosophy, (2)	7	History of Philosophy, (2)	8
French, (3)	80, 84 *or* 87	French, (3)	81, 85 *or* 87
or German, (3)	96	*or* German, (3)	97
Business Law, (2)	20	Business Law, (2)	20
Electives, (10)	see page 34	Thesis, (3)	
Physical Education, (1)	442	Electives, (7)	see page 34
		Physical Education, (1)	442

The figures in parentheses indicate the number of exercises per week.

ELECTIVE STUDIES

From the following list of elective studies have been excluded in general those studies which, peculiarly technical or professional, enter into the combined academic and engineering courses. See page 31.

Many of the subjects are not restricted to the years to which they are assigned, but may be taken subsequently. But this privilege is limited by considerations of the roster, and the principle that the course of each student shall be systematic, and not haphazard.

Students are required to submit their electives to the Professor in charge of electives, for the first term on or before May 1, for the second term on or before December 15, in order that they may be incorporated into the general roster of the University.

SOME SOPHOMORE ELECTIVES

FIRST TERM		SECOND TERM	
Physiography, (3)	281	Physiography of U. S., (3)	282
Greek, (3)	52	Greek, (3)	53
Latin, (3)	43	Latin, (3)	44
French, (3)	72	French, (3)	72
Advanced Algebra, (2)	143	Solid Anal. Geom., } (5)	145
Plane Analytic Geom., (3)	144	Diff. Calculus, }	
Chemical Philosophy, (3)	395	Advanced Chemistry, (3)	403
History of Commerce, (3)	37	Scientific Method, (2)	9
		History of Commerce, (3)	37

SOME JUNIOR ELECTIVES

FIRST TERM		SECOND TERM	
English, (3)	129	Eng'ish, (3)	131
Greek, (3)	54 *or* 56	Greek, (3)	55 *or* 57
Latin, (3)	45 *or* 47	Latin, (3)	46 *or* 48
Spanish, (3)	111	Spanish, (3)	111
or Italian, (3)	115	*or* Italian, (3)	115
German, (3)	96, 98 *or* 100	German, (3)	97, 98 *or* 100
French, (3)	82, 84 *or* 86	French, (3)	83, 85 *or* 87
Integral Calculus, (4)	145	Analytic Mechanics, (2)	147
Advanced Algebra, (1)	143a	Differential Equations, (1)	146
Physics, (4)	322, 322a	Physics, (4)	323, 323a
QuantitativeAnal., (4)	397,398	Quant. Analysis, (4)	399, 402
History, (3)	35	History, (3)	34 *or* 36
Industrial History, (3)	38	Industrial History, (3)	38
Education, (3)	11	Education, (3)	12
Mineralogy, (4)	266	Astronomy, (3)	148
		Botany, (2)	290
		Economic Geology, (2)	272
		Comparative Anatomy, (3)	293

SOME SENIOR ELECTIVES

FIRST TERM

English, (3) 132
Roman Law, (3) 48
Greek, (3) 54 *or* 56
Italian, (3) 115 *or* 116
Spanish, (3) 111 *or* 112
German, (3) 98, 101 *or* 102
French, (3) 84, 86, 87 *or* 88
Economics, (2) 18 *or* 20
Public Law, (3) 22 *or* 24
Education, (2) *or* (3) 13
Psychology, (2), (3), *or* (4) 3, 5, 6
Practical Astronomy, (3) 149
Theory of Light, (5) 329
Elec. and Magnetism, (2) 325
Dynamos and Motors, (2) 354
Dynamo Laboratory, (1) 355
Physical Chem., (4) 420, 421
Organic Chem., (5) 409, 410
Petrography, (2) 279
Embryology, (2) 294
Bacteriology, (2) 296
French Composition, (2) 79

SECOND TERM

English, (3) 133 *or* 134
Latin, (3) 47
Greek, (3) 55, 57, *or* 58
Italian, (3) 115 *or* 116
Spanish, (3) 111 *or* 112
German, (3) 98, 101 *or* 102
French, (3) 85, 86, 87 *or* 89
Economics, (2) 19 *or* 21
Public Law, (2) 23 *or* 25
Education, (2) *or* (3) 13
Psychology, (2), (3), *or* (4) 3, 5, 6
Theory of Heat, (4) 329
Electrical Engineering, (2) 362
Electrical Laboratory, (1) 327
Dynamo Laboratory, (1) 356
Alternating Currents, (2) 357
Sanitary Chemistry, (3) 419
Organic Chemistry, (7) 411, 412
Petrography, (1) 280
Econ. Geol., (2), *or* (3) 272 *or* 274
Advanced Bacteriol., (2) 297
Sanitary Biology, (2) 295
French Composition, (2) 79

B. COURSES LEADING TO THE DEGREE OF BACHELOR OF SCIENCE

Four plans of study leading to the degree of Bachelor of Science are offered by the University in the Department of Arts and Science. These are:

1. A course in which the Biological and Chemical sciences predominate.
2. A course in which the Geological sciences predominate.
3. A course in which Mathematical and Physical sciences predominate.
4. A course in Business Administration.

These courses are based upon entrance requirements which embrace a large variety of subjects commonly taught in the High Schools of the State, without, however, enforcing upon applicants for admission the necessity of the higher mathematics required for admission to the engineering courses of the University, or the amount of Latin required for admission to the course leading to the degree of Bachelor of Arts.

To give these courses purpose and coherence they are planned along definite lines, having in view proficiency in some special branch of science but with such an admixture of literary, economic, and philosophic studies as may give them breadth and save them from becoming distinctly professional courses. The work, therefore, included in the several plans of study is largely fixed. In the general conduct of his work, a student is under the direction of the head of the department in which the main content of his course lies.

These courses are designed to meet the needs of several classes of men: those who are preparing for the study of medicine, for which a college training in biology, chemistry and allied subjects, as well as in liberal studies, is almost essential; those who are preparing for the study of law, for whom a college course in history, economics, and sociology is equally valuable; men who will find employment in the Geological Survey work of the Government, or as exploratory or economic geologists in connection with mining organizations; those who are contemplating a business career, or the management of industrial and financial enterprises; those who will use these courses, in whole or in part, as the basis of a broader technical training; and men who are preparing to become teachers. There is a distinct need for well-trained

teachers of sciences in the secondary schools of the State, and the scientific spirit and equipment of this University peculiarly qualify it for the work. (See further the Courses for Teachers, page 42.)

The course in Business Administration is to prepare young men for the commercial and administrative sides of our leading business organizations. It is intended for those who have no inclination for the engineering courses, but who are desirous of obtaining a knowledge of the fundamentals of mining, metal, and transportation industries. This knowledge combined with that derived from a study of economics, finance, accounting, and business law makes a significant appeal to those looking forward to business careers in private life or as public officials.

These Courses are open to any students who present the entrance requirements for the B.S. courses in the Department of Arts and Science. For the students presenting the entrance requirements for the B.A. course special arrangements will be made to enable them to take the work.

Following is an outline of the plans of study of these several courses. For the first three of these courses the work of the Freshman year is the same. After that they begin to differentiate.

The work of these courses covers four years and on its completion the degree of B.S. is conferred.

SCHEDULES OF STUDIES OF THE B.S. COURSES

FRESHMAN YEAR

In the Biological, Geological, and Mathematical courses the studies of the Freshman Year are the same.

FIRST TERM		SECOND TERM	
English, (3)	120, 121, 125	English, (2)	122, 125
German, (3)	96	German, (3)	97
or French, (3)	74	*or* French, (3)	75
Plane Trigonometry, (3)	141	Solid Geometry, (2)	140
Chemistry, (2)	390	Spherical Trig., (1)	142
Chemical Laboratory, (2)	391	Qualitative Analysis, (3)	393
ElementaryMechanics,(2)	320	Stoichiometry, (1)	394
Freehand Drawing, (1)	155	Elem. Mechanics, (5)	321, 321a
Science and Scientists, (1)	15	Gymnasium, (2)	440
Gymnasium, (2)	440		

1. COURSE IN WHICH BIOLOGY AND CHEMISTRY PREDOMINATE

FRESHMAN YEAR (See page 36.)

Students who enter on German continue it in the Freshman and Sophomore years, and take French in the Junior and Senior years. Those who enter on French continue it in the Freshman year and take German for three years beginning in the Sophomore year.

Students who purpose to leave the University at the end of the Sophomore year to enter a medical college substitute Biology (3) in the first term and Comparative Anatomy (3) in the second term for the English of the Sophomore year.

FIRST TERM	SOPHOMORE YEAR	SECOND TERM	
Quantitative Analysis, (5)	396	Advanced Chemistry, (3)	403
Quant. Anal. Conf., (1)	398	English, (2)	124, 126
Chemical Philosophy, (3)	395	German, (3)	98 *or* 91
English, (2)	123, 126	Physics, (4)	323, 323a
German, (3)	98 *or* 90	General Geology, (2)	270
Physics, (4)	322, 322a	Geological Lab., (1)	271
Physical Education, (1)	442	Botany, (2)	290
		Physical Education, (1)	442

FIRST TERM	JUNIOR YEAR	SECOND TERM	
Biology, (3)	292	Comparative Anatomy, (3)	293
Psychology, (2)	1	Scientific Method, (2)	9
Physiography, (3)	281	Psychology, (2)	2
French, (3)	70	Organic Chemistry, (4)	411
or German, (3)	96	Organic Chem. Lab., (3)	412
Economics, (2)	16	French, (3)	71
Organic Chemistry, (3)	409	*or* German, (3)	97
Organic Chem. Lab., (2)	410	Economics, (2)	17
Physical Education, (1)	442	Physical Education, (1)	442

FIRST TERM	SENIOR YEAR	SECOND TERM	
Embryology, (3)	294	Sanitary Chemistry, (3)	419
Bacteriology, (2)	296	History of Philosophy, (2)	8
History of Philosophy, (2)	7	Education, (2)	12
Education, (2)	11	French, (3)	81
French, (3)	80	*or* German, (3)	98
or German, (3)	98	History, (3)	34 *or* 36
Business Law, (2)	20	Business Law, (2)	20
Physical Chemistry, (3)	420	Thesis in Biology, (3)	
Physical Chem. Lab., (1)	421	Physical Education, (1)	442
Physical Education, (1)	442		

Students may, with the approval of the Faculty, substitute for some of the subjects in the Junior and Senior years, other subjects which will better suit their future aims.

The figures in parentheses indicate the number of exercises per week.

2. COURSE IN WHICH THE GEOLOGICAL SCIENCES PREDOMINATE

FRESHMAN YEAR (See page 36.)

Students who enter on German continue it in the Freshman and Sophomore years, and take French or Spanish in the Junior year. Those who enter on French continue it in the Freshman year and take German in the Sophomore and Junior years. In special cases Spanish may be substituted for either German or French.

FIRST TERM	SOPHOMORE YEAR	SECOND TERM	
English, (2)	123, 126	English, (2)	124, 126
German, (3)	98 *or* 90	German, (3)	98 *or* 91
Physics, (4)	322, 322a	Physics, (4)	323, 323a
Mineralogy, (5)	267	Advanced Chemistry, (3)	403
Blowpipe Analysis, (1)	268	Blowpipe Analysis, (1)	269
Quantitative Analysis, (3)	397	General Geology, (2)	270
Quant. Anal. Conf., (1)	398	Petrology & Geol. Lab., (3)	271
Physical Education, (1)	442	Physical Education, (1)	442

FIRST TERM	JUNIOR YEAR	SECOND TERM	
French, (3)	70	French, (3)	71
or Spanish, (3)	111	*or* Spanish, (3)	111
or German, (3)	96	*or* German, (3)	97
Petrography, (2)	279	Petrography, (1)	280
Structural Geology, (1)	284	Psychology, (2)	2
Psychology, (2)	1	Economics, (2)	17
Economics, (2)	16	Economic Geology, (2)	272
Mechanical Drawing, (2)	312	Metallurgy, (3)	248-250
Biology, (3)	292	Land Surveying, (4)	163
Assaying, (3)	414	Physiography, (2)	277
Physical Education, (1)	442	Physical Education, (1)	442

FIRST TERM	SENIOR YEAR	SECOND TERM	
Field Geology, (2)	278	Geology of N. America, (3)	276
Paleontology, (2)	275	Economic Geology, (3)	274
Mining and Geol. Law, (1)	283	History of Philosophy, (2)	8
History of Philosophy, (2)	7	Business Law, (2)	21
Business Law, (2)	20	Sanitary Biology, (2)	295
Ore Dressing, (3)	309, 310	Geological Methods, (3)	285
Prospecting, (2)	299	Thesis in Geology, (3)	
Forestry, (3)	291	Physical Education, (1)	442
Physical Education, (1)	442		

Students may, with the approval of the Faculty, substitute for some of the subjects in the Junior and Senior years other subjects which will better suit their future aims.

The figures in parentheses indicate the number of exercises per week.

3. COURSE IN WHICH PHYSICS AND MATHEMATICS PREDOMINATE

FRESHMAN YEAR (See page 36.)

Students who enter on German continue it in the Freshman and Sophomore years, and take French in the Junior and Senior years. Those who enter on French continue it in the Freshman year and take German for three years beginning in the Sophomore year.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Mechanical Drawing, (2)	160	German, (3)	98 *or* 91
German, (3)	98 *or* 90	Physics, (4)	323, 323a
Physics, (4)	322, 322a	Solid Analytic Geom., } (5)	145
Advanced Algebra, (2)	143	Differential Calculus, }	
Plane Analytic Geom., (3)	144	Descriptive Geometry, (3)	161
Quantitative Analysis, (3)	397	Quantitative Analysis, (3)	399
Physical Education, (1)	442	Physical Education, (1)	442

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Elec. and Magnetism, (2)	325	Differential Equations, (1)	146
Electrical Laboratory, (1)	326	Analytic Mechanics, (2)	147
Integral Calculus, (4)	145	French, (3)	71
Advanced Algebra, (1)	143a	*or* German, (3)	95
French, (3)	70	Advanced Chemistry, (3)	403
or German, (3)	94	Psychology, (2)	2
Psychology, (2)	1	Economics, (2)	17
Economics, (2)	16	Astronomy, (3)	148
Chemical Philosophy, (3)	395	Scientific Method, (2)	9
Physical Education, (1)	442	Physical Education, (1)	442

SENIOR YEAR

FIRST TERM		SECOND TERM	
French, (3)	80	French, (3)	81
or German, (3)	98	*or* German, (3)	98
History of Philosophy, (2)	7	History of Philosophy, (2)	8
Practical Astronomy, (3)	149	Alternating Currents, (2)	357
Dynamos and Motors, (2)	354	Electrical Laboratory, (1)	327
Dynamo Laboratory, (1)	355	Analytic Mechanics, (3)	150
Mineralogy, (4)	267	General Geology, (2)	270
Biology, (3)	292	Geological Lab., (2)	271
or Education, (3)	11	Thesis in Physics or Mathematics, (3)	
Physical Education, (1)	442	Physical Education, (1)	442

Students may, with the approval of the Faculty, substitute for some of the subjects in the Junior and Senior years other subjects which will better suit their future aims.

The figures in parentheses indicate the number of exercises per week.

4. THE COURSE IN BUSINESS ADMINISTRATION

With the application of more scientific methods in all branches of human enterprise, comes a growing need of special preparation to enter the business world. Successful men who entered upon their careers, thirty, forty, or fifty years ago can hardly realize that special training is necessary for business success, for they laid the foundation of their prosperity before the present highly specialized industrial and commercial period. Formerly it was common for a young man to enter an office or financial institution and to work his way to some directive position, but this becomes less and less possible as business becomes increasingly complicated and technical.

As efficiency is the keynote of future prosperity in American industry, the Course in Business Administration is designed to train men to cope ably with problems of business life and to inculcate into the minds of the coming industrial generation the idea that it is only by efficiency that we can hope to maintain national supremacy.

The Course in Business Administration is a "technical" course. It takes into account the fact that there is a Science of Business, with Economics as its underlying basis. The important subdivisions of the science of Economics, such as Accounting, Finance, Political Science, Transportation, Industry, Industrial Management, etc. (see page 76), are offered under the course. A certain amount of work, which is not included under the head of Economics, is given in order to insure a well rounded development.

The Course stands in the same relation to the life and calling of the manufacturer, the merchant, and other men of business as do the law and medical schools of the universities to lawyers and physicians. It provides a systematic training in the structure and organization of modern industry and commerce, and in the general causes and criteria of prosperity and depression.

The Course is not only designed to prepare young men to enter business life, but it also offers preliminary training for the study of law, accountancy, public service and teaching.

The work of the Course covers four years and on its completion the degree of Bachelor of Science (B.S.) is conferred.

4. THE COURSE IN BUSINESS ADMINISTRATION

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
English, (3)	120, 121, 125	English, (2)	122, 125
German, (3)	96	German, (3)	97
or French, (3)	74	*or* French, (3)	75
or Spanish, (3)	111	*or* Spanish, (3)	111
Industrial History, (2)	38	Industrial History, (2)	38
Plane Trigonometry, (3)	141	Solid Geometry, (2)	140
Chemistry, (2)	390	Spherical Trig., (1)	142
Chemical Laboratory, (2)	391	Qualitative Analysis, (3)	393
Blue Print Reading, (1)	26b	Stoichiometry, (1)	394
Science and Scientists, (1)	15	Blue Print Reading, (1)	26b
Gymnasium, (2)	440	Gymnasium, (2)	440

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Physiography, (3)	281	Physiography of U. S. (3)	282
Accounting, (3)	26	Accounting, (3)	26a
Constitutional Law, (3)	22	Constitutional Law, (3)	22
Economics, (3)	16	Economics, (3)	17
Economic Geography of N. and So. America, (3)	27	Economic Geography of N. and So. America, (3)	27
Spanish, (3)	112	Spanish, (3)	112
Physical Education, (1)	442	Physical Education, (1)	442

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Business Law, (2)	20	Business Law, (2)	21
U. S. History, (3)	36 *or* 37	U. S. History, (3)	36 *or* 37
Labor Legislation, (2)	29	Labor Legislation, (2)	29
R. R. Administration, (2)	28	R. R. Administration, (2)	28
Statistics, (3)	32a	Statistics, (3)	32a
Economic Geography of the Eastern Hemisphere, (3)	27a	Economic Geography of the Eastern Hemisphere, (3)	27a
Psychology, (2)	1	Psychology, (2)	2
Physical Education, (1)	442	Physical Education, (1)	442

SENIOR YEAR

FIRST TERM		SECOND TERM	
Finance, (3)	18	Finance, (3)	19
Banking and Currency, (3)	33	Banking and Currency, (3)	33
Investments, (3)	32	Investments, (3)	32
Mod. European History, (3)	35	Mod. European History, (3)	35
International Law, (3)	23 *or* 24	International Law, (3)	23 *or* 25
Industrial Management, (2)	30	Industrial Management, (2)	30
Physical Education, (1)	442	Thesis,	
		Physical Education, (1)	442

Students may, with the approval of the Faculty, substitute for some of the subjects in the Junior and Senior years, other subjects which will better suit their future aims.

The figures in parentheses indicate the number of exercises per week.

C. COURSES FOR TEACHERS

For some years past Lehigh University has been able partly to meet the demands made upon her for teachers by recommending men who have received here special training for the teacher's profession. More emphasis is being laid each year by school superintendents and principals upon the need for such training before men leave college. A knowledge of the theory of teaching is required for a license to teach in the public schools. It is our special aim to associate all instruction in the theory of education with the actual work to be done in the school room. This aim is promoted by our evening practice school, which provides for every student who desires it an opportunity to practice teaching under supervision. Visits also are made in connection with each course to neighboring schools, both public and private, and the work observed is carefully criticised and discussed.

The Bethlehem Board of Education has made provision for practice teaching by Lehigh students in the Bethlehem High School and in the grades.

The courses offered by the Department of Philosophy and Education that are commonly recognized as especially helpful to the teacher include the required courses in Psychology and the History of Philosophy, and also the History of Education, Educational Theory and Practice, Scientific Method, additional elective courses in Psychology, and the practice teaching. In these courses a total of twenty-three term hours may be taken in the Sophomore, Junior and Senior years. Thus it will be seen that Lehigh offers more pedagogical training than is demanded for a provisional college graduate certificate according to the new school code. In arranging his curriculum the man who intends to teach should also have in mind early in his college career the importance of specializing in one line, and of being thoroughly competent in one or two related lines. The courses outlined on the following pages offer ample opportunity for the selection of subjects on this plan. The graduate is at a disadvantage who, when he begins his career as a teacher, either has no specialty, on the one hand, or is incompetent in anything but his specialty, on the other. Few young men realize how rapidly the profession of teaching is moving toward higher standards of efficiency and of remuneration. In Pennsylvania, the outlook is particularly favorable for men of character and intelligence.

D. COMBINED ACADEMIC AND ENGINEERING COURSES

The University has long recognized the advantage of a broader education for an engineer than is possible within the limitations of the commonly accepted entrance requirements for an engineering course, and an engineering curriculum of four years, which of necessity is largely occupied by subjects of a technical and professional nature. The number of college graduates who choose engineering as a profession is increasing from year to year; and inasmuch as many of the subjects, *e.g.*, higher mathematics, physics, chemistry, which are essential to an engineering course, belong properly also in a college curriculum, college graduates usually fulfill the requirements for an engineering degree in from two to three years: the length of time depends largely upon the choice and character of the work of the college course. But a college graduate who subsequently proceeds to engineering study often finds that his training in subjects common to the two courses is inadequate to the successful application of them to engineering work. Time can be saved, a better correlation of work secured, when both courses are under one common guidance.

The University is able, by systematically combining the studies of its several engineering schools with the studies peculiar to its courses in Arts and Science, to offer courses of six years' duration which lead to the degree of Bachelor of Arts or Bachelor of Science, and an engineering degree, and in which neither the purpose nor the efficiency of either course is sacrificed. Students in these courses receive the Bachelor's degree at the end of four years, and the engineering degree upon the completion of the engineering studies.

Men of exceptional ability and diligence whose course in the preparatory school has been in advance of the Freshman entrance requirements for the B.A. or B.S. courses may complete a combined academic and engineering course in five years.

Following is the schedule of studies of a six years' course leading to the degrees of Bachelor of Arts and Civil Engineer. Combined courses leading to other engineering degrees, and likewise in combination with the Bachelor of Science courses are also provided.

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Latin, (4)	40	Latin, (5)	41, 42
or Greek, (4)	50	English, (2)	122, 125
English, (3)	120, 121, 125	Solid Geometry, (2)	140
Plane Trigonometry, (3)	141	Spherical Trig., (1)	142
Chemistry, (2)	390	Greek, (4)	51
Chemical Laboratory, (2)	391	*or* { Qual. Analysis, (3) / Stoichiometry, (1)	393 / 394
German, (3)	90 *or* 96	German, (3)	91 *or* 97
or French, (3)	74	*or* French, (3)	75
Gymnasium, (2)	440	Gymnasium, (2)	440

Students who have entered on Greek will take Greek, those who have entered on French will take French in the Freshman year. Course 96 in German is for students who have entered on German, course 90 for those who have entered on Greek or French, who, however, may take course 96 if qualified.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
English, (2)	123, 126	English, (3)	124, 126, 128
History, (3)	35	History, (3)	36
German, (3)	98	German, (3)	98
Advanced Algebra, (2)	143	Solid Analytic Geom., / Differential Calculus, (5)	145
Plane Analytic Geom., (3)	144		
Elementary Mechanics, (2)	320	Elem. Mechanics, (5)	321, 321a
Physical Education, (1)	442	Physical Education, (1)	442

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Psychology, (2)	1	Psychology, (2)	2
Economics, (2)	16	Economics, (2)	17
French, (3)	70	French, (3)	71
or German, (3)	90	*or* German, (3)	91
Biology, (3)	292	Physics, (4)	323, 323a
Physics, (4)	322, 322a	Analytic Mechanics, (2)	147
Integral Calculus, (4)	145	Descriptive Geometry, (3)	161
Mechanical Drawing, (2)	160	Physical Education, (1)	442
Physical Education, (1)	442		

SENIOR YEAR

FIRST TERM		SECOND TERM	
History of Philosophy, (2)	7	History of Philosophy, (2)	8
Mineralogy, (4)	266	French, (3)	81
Stereotomy, (3)	162	*or* German, (3)	97
Construction, (2)	168	Business Law, (2)	20
French, (3)	80	General Geology, (2)	270
or German, (3)	96	Geological Lab., (2)	271
Business Law, (2)	20	Land Surveying, (4)	163
Physical Education, (1)	442	Construction, (2)	169
		Thesis for B.A., (3)	
		Physical Education, (1)	442

SUMMER TERM

Topographic Surveying, 166.

FIFTH YEAR

FIRST TERM		SECOND TERM	
Strength of Materials, (4)	172	Hydraulics, (3)	177
Graphic Statics, (2)	174	Roofs and Bridges, (3)	176
Testing Laboratory, (1)	186	Hydraulic Laboratory, (1)	187
Roads and Pavements, (2)	175	Astronomy, (3)	148
Metallurgy, (3)	248-250	Railroad Surveying, (4)	165
Electrotechnology, (2)	372	Steam Engines, (3)	205
Dynamo Laboratory, (1)	355	Physical Education, (1)	442
Physical Education, (1)	442		

SUMMER TERM

Engineering Inspection, 184.

SIXTH YEAR

FIRST TERM		SECOND TERM	
Bridge Design, (6)	178	Bridges and Dams, (4)	180
HydraulicEngineering, (4)	182	Sanitary Engineering, (3)	183
Railroads, (2)	170	Sanitary Biology, (2)	295
Steel Buildings, (2)	179	Railroads, (2)	171
Geodetic Surveying, (3)	167	Cement and Concrete, (3)	181
or Prac. Astronomy, (3)	149	Thesis for C. E., (3)	188
Physical Education, (1)	442	Physical Education, (1)	442

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN CIVIL ENGINEERING

The requirements for admission to this course may be found on page 18. While French will be accepted instead of German, it is recommended that the latter be offered, as its technical literature is of greater value to the civil engineer.

The purpose of this course is to give a broad education in those general and scientific subjects which form the foundation of all branches of technology, and special training in those subjects comprised under the term civil engineering. The aim of the department is to teach young men how to think, and how to attack new problems; to impress upon them the underlying principles of engineering and to inspire them with a desire to do their best work. The graduate is not only prepared to enter upon the location and construction work of railroads, bridges, water works, or sewerage plants, but can advantageously take up allied work in mining, mechanical, electrical, or architectural engineering.

During the Freshman year the time is mostly devoted to fundamental studies which give both general culture and preparation for the technical work of the following years. The study of Mathematics, Physics, English, and German is continued. Chemistry is taught partly by lectures and partly by practical manipulation in the laboratory. Drawing is done throughout the year, and, as is the case in practically all the courses in drawing presented by the Civil Engineering Department, the drawing room exercises are supplemented by recitations. There are lectures in Physiology and Hygiene, and systematic exercise in the gymnasium is required.

In the Sophomore year the fundamental subjects of Mathematics, Physics, and English are completed, and the technical work of civil engineering is begun by practical problems in Drawing and by lectures or recitations on Construction. The theory of Land Surveying is begun and is accompanied by field work and map drawing. Those who desire to take this subject in the vacation at the end of the Freshman year will be allowed to do so under the regulations stated on page 90.

The work in Topographic Surveying is done in the four weeks following the end of the Sophomore year. By this arrangement the attention of the student is concentrated upon a single subject, thus enabling practical field operations to be exemplified in the best possible manner. In Railroad Surveying both preliminary and final locations of a line are made, and plans, profiles, and estimates of cost are prepared. In Geodetic Surveying triangulations

of a high degree of precision are executed, as also determinations of azimuth, and adjustments of the results are made by the standard methods. A large collection of levels, transits, and other surveying instruments enables the student to become familiar with the instruments of the best manufacturers.

Under the head of Construction and of Cement and Concrete are grouped the topics of masonry, foundations, cements and mortars, walls, dams, arches, tunnels, and details of structures. The work covers three terms and is carried on by recitations and lectures using standard books and engineering journals. Visits of inspection to structures in the Lehigh Valley and vicinity are made, and written reports upon them are required. All the standard tests of cements and mortars are made by each student. In connection with the subject of Strength of Materials there is also work in the testing laboratory on timber, brick, iron, and steel.

The testing of materials is of great importance not only because of its effect on the student's understanding of the mechanics of engineering but because it gives him the ability to manipulate apparatus and to handle machines in a way that should prove useful in his future work.

Roofs and Bridges receive attention throughout four terms. The analysis of trusses by graphic methods is begun in the first term of the Junior year and later the analytical methods of computing stresses are taken up. Visits are made to bridges and sketches taken of details which are afterwards drawn to scale. Later, in the Senior year, designs and working drawings are prepared by each student for both highway and railroad bridges. Some of these drawings are made in the same manner as in the drawing room of a bridge company, while others are general, that is, design drawing only, and estimates of the final weight of the structure are prepared. The theory of cantilever, draw, suspension, and arched structures receives detailed attention, as also that of reinforced concrete structures. This extended training in bridge engineering furnishes a thorough foundation for successful work in practice.

Hydraulic and Sanitary Engineering are treated at length. The theory of the flow of water through orifices, weirs, pipes, and channels, together with the principles of hydraulic motors, is given in the Junior year, while in the Senior year the subjects of water supply and sewerage are discussed. The methods of collecting, purifying, and distributing water are explained and

compared; house drainage, the design of sewerage systems, and the disposal of sewage also receive attention. Computations for dams, standpipes, sewers and their appurtenances are made. Canal engineering, river and harbor work, and land drainage receive attention. Irrigation by both water and sewage is also discussed. This training in hydraulic and sanitary subjects, together with that in Construction, renders the graduate well qualified to enter upon the work of city engineering. In connection with the course in Hydraulic Engineering, measurements are made of the flow in the Lehigh River, the Lehigh Canal and other streams in the vicinity of South Bethlehem and the data thus obtained are studied later in the drawing room. In view of the increasing importance of water-power development this work is of great value and importance.

Among other required subjects may be noted that of Strength of Materials, which gives the theory of beams, columns, and shafts, and the methods of computing and designing them; as already noted, this subject is exemplified by practical work in the testing laboratory. The subject of Electrotechnology treats of the construction and operation of dynamos and motors. The subjects of Mineralogy and Metallurgy give excellent training in the observation of natural phenomena, and prepare the student for work in Geology and allied subjects.

In the first term of the Senior year the student may elect either Practical Astronomy or Geodetic Surveying. Extra subjects may also be pursued, by permission of the Faculty, if the time of the student permits. In these subjects, as well as in all the work of this course, it is the aim to exemplify the theoretical principles by practical problems, inspections, designs and laboratory exercises. The testing laboratory of the University contains machines for making physical tests of tension, compression, flexure and torsion, and is of special value to students who prepare theses on investigations of the properties of materials.

For description of the Fritz Engineering Laboratory, which is operated by the Civil Engineering Department, see page 132.

The student who completes this course receives the degree of Civil Engineer. Mature young men desiring to take special studies without being candidates for the degree will be afforded every facility in so doing. Graduates of this course may become candidates for the degree of Master of Science under the regulations stated on page 117.

THE COURSE IN CIVIL ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Plane Analytic Geom., (3)	144	Solid Analytic Geom., } (5)	145
Advanced Algebra, (2)	143	Differential Calculus, }	
Chemistry, (2)	390	Elem. Mechanics, (5)	321, 321a
Chemical Laboratory, (2)	391	German, (3)	95
Elementary Mechanics, (2)	320	*or* French, (3)	75
German, (3)	94	Descriptive Geometry, (3)	161
or French, (3)	74	English, (2)	122, 125
Mechanical Drawing, (2)	160	Gymnasium, (2)	440
English, (3)	120, 121, 125		
Gymnasium, (2)	440		

SUMMER TERM

Land Surveying (optional), 163.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Integral Calculus, (4)	145	Analytic Mechanics, (2)	147
Spherical Trig., (1)	142	Physics, (4)	323, 323a
Physics, (4)	322, 322a	Construction, (2)	169
Construction, (2)	168	Land Surveying, (4)	163
Stereotomy, (3)	162	General Geology, (2)	270
Mineralogy, (4)	266	Geological Lab., (2)	271
English, (2)	123, 126	English, (3)	124, 126, 128
Physical Education, (1)	442	Physical Education, (1)	442

SUMMER TERM

Topographic Surveying, 166.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Strength of Materials, (4)	172	Hydraulics, (3)	177
Graphic Statics, (2)	174	Hydraulic Laboratory, (1)	187
Testing Laboratory, (1)	186	Roofs and Bridges, (3)	176
Roads and Pavements, (2)	175	Astronomy, (3)	148
Metallurgy, (3)	248-250	Railroad Surveying, (4)	165
Electrotechnology, (2)	372	Steam Engines, (3)	205
Dynamo Laboratory, (1)	355	Economics, (1)	17
Economics, (2)	16	Physical Education, (1)	442
Physical Education, (1)	442		

SUMMER TERM

Engineering Inspection, 184.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Bridge Design, (6)	178	Bridges and Dams, (4)	180
Hydraulic Engineering, (4)	182	Sanitary Engineering, (3)	183
Railroads, (2)	170	Sanitary Biology, (2)	295
Steel Buildings, (2)	179	Railroads, (2)	171
Geodetic Surveying, (3)	167	Cement and Concrete, (3)	181
or Prac. Astronomy, (3)	149	Thesis, (3)	188
Physical Education, (1)	442	Physical Education, (1)	442

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN MECHANICAL ENGINEERING

The object of this course is the study of the Science of Machines. The principal subjects taught are: the nature, equivalence, and analysis of mechanisms, the mechanics or theory of the principal classes or types of machinery, mechanical technology, the principles and practice of machine design, and the measurements of power.

The earliest shop visits are for the purpose of acquainting beginners with machine parts and the usual tools of a shop. These visits are a part of the work of a summer term, lasting four weeks, which is held at the close of the second term of the Freshman year.

In the same summer term the students of Mechanical Engineering are also given a course in the examination of electrical instruments and machinery and in the inspection of their use and operation in electrical plants. This is regarded as a very desirable preliminary to the study of physics and to the special course in Electrical Engineering which is pursued later on.

A second summer term at the end of the Sophomore year provides a course of shop instruction (Mechanical Technology) which is principally devoted to familiarizing the students with those points in pattern-making, moulding, forging, fitting and finishing, that they need to know as designers of machinery.

The instruction in Machine Design begins in the first term of the Sophomore year and is continued throughout the year. There is a thorough drill in projection drawing. In this work freehand sketches are first made and measurements taken of machine pieces; these sketches are then converted into full-sized drawings. Then there is considerable practice in the interpretation of such drawings. This is followed by difficult projections and intersections and exercises in the empirical proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice and the drawings made full size. In the last year the Seniors undertake the calculations, estimates, and working drawings involved in the design of simple but complete machines, each student being engaged upon different machines. In the case of these machines and of the engine the general plan of arrangement is given to the students

in the form of rough sketches, photographs or wood cuts. In the last term the Seniors are expected to make original designs for simple machinery, the object of which has been fully explained.

The students in Mechanical Engineering are given a special course in Electrical Engineering after they have finished the regular and general course in Physics. The object is to impart a clear conception of electrical units and a working knowledge of resistance, impedance, inductance, reactance, capacity, and the magnetism of iron, and the magnetic circuit as used in the construction of electrical machinery. Attention is then directed to the theory and calculation of direct current dynamos, to the study of variable and alternating current phenomena, and to the theory of the alternating current transformer. Practical problems are given in these subjects to show their application. The laboratory work which accompanies this special course involves tests of resistance, insulation, consumption of energy, and efficiency.

The course in Engineering Laboratory begins with the handling and calibration of the instruments and appliances belonging to the experimental side of mechanical engineering; the simpler tests and experiments, along various lines, are taken up next; and there is a gradual progress toward complex operations as the complete test of a power plant or pumping station, or a full thermodynamic test of the steam engine. The course is, at present, most fully developed in the field of steam engineering, where it embraces steam calorimetry, flow of steam, the testing of steam-traps and separators, and of injectors, small pumps, and the steam turbine; extensive practice with the indicator, engine tests of various sorts, and boiler testing.

Gas engineering, work with compressed air, tests of hot-air engines, of centrifugal pumps, and of various incidental appliances and apparatus, are given due place in the course. Time is also devoted to dynamometer work with experiments in friction and lubrication, and determination of the efficiency of machines.

The purpose of this course, kept in view in the equipment and arrangement of the laboratory, is to provide a system of well-selected and graded experiments which will illustrate and impress principles, develop the skill and judgment of the student, and give a broad training in the idea, method, and detail of this sort of work.

Graduates in this course receive the degree of Mechanical Engineer (M.E.).

THE COURSE IN MECHANICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Plane Analytic Geom., (3)	144	Solid Analytic Geom., } (5)	145
Advanced Algebra, (2)	143	Differential Calculus, }	
Chemistry, (2)	390	Elem. Mechanics, (5)	321, 321a
Chemical Laboratory, (2)	391	Qualitative Analysis, (3)	393
Elementary Mechanics (2)	320	Stoichiometry, (1)	394
German, (3)	94	German, (3)	95
or French, (3)	74	*or* French, (3)	75
Freehand Drawing, (1)	155	English, (2)	122, 125
English, (3) 120, 121,	125	Gymnasium, (2)	440
Gymnasium, (2)	440		

SUMMER TERM Constructive Elements of Machinery and of Electrical Apparatus, 201, 350.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Integral Calculus, (4)	145	Differential Equations, (1)	146
Physics, (4) 322,	322a	Analytic Mechanics, (2)	147
Elem. Mech. Materials, (1)	185	Physics, (4) 323,	323a
Drawing and Mach. Des., (3)	200	Steam Engine, (4)	204
Boilers, (1)	203	French, (3)	71
French, (3)	70	*or* German, (3)	91
or German, (3)	90	English, (2)	124, 126
English, (3) 123, 126,	128	Machine Design, (3)	202
Physical Education, (1)	442	Physical Education, (1)	442

SUMMER TERM Mechanical Technology, 206.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Mech. of Machinery, (2)	207	Mech. of Machinery, (3)	211
Graphic Statics, (2)	173	Hydraulics, (3)	177
Dynamos and Motors, (2)	354	Electrical Laboratory, (1)	327
Dynamo Laboratory, (1)	355	Engineering Lab., (1)	209
Elec. and Magnetism, (2)	325	Electrical Engineering, (2)	362
Electrical Laboratory, (1)	326	Dynamo Laboratory, (1)	356
Engineering Lab., (2)	208	Alternating Currents, (2)	357
Strength of Materials, (4)	172	Metallurgy, (3)	248-250
Economics, (1)	16	Economics, (1)	17
French, (2)	78	French, (2)	78
or German, (2)	92	*or* German, (2)	93
Physical Education, (1)	442	Physical Education, (1)	442

SUMMER TERM Engineering Laboratory, 212.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Thermodynamics, (5)	216	Machine Design, ( )	224
Kinematics of Mach., (4)	217	Engineering Lab., (1)	228
Machine Design, (4)	218	Mech. of Machinery, (4)	227
Engineering Lab., (1)	220	Steam Turbines, (5)	229
Gas Engines, (3)	230	Industrial Management, (2)	30
Business Law, (1)	20	Thesis, (3)	231
Industrial Management, (2)	30	Physical Education, (1)	442
Physical Education, (1)	442		

A special option in Electrical Engineering may be arranged.

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN METALLURGICAL ENGINEERING

This course is designed to prepare the student for practice in the field of metallurgy. In addition to the general studies underlying all technical education, instruction is given in Freehand and Projection Drawing, the Strength of Materials, Testing Laboratory, Mechanical Technology, Steam Boilers, the Steam Engine, the Mechanics of Machinery, involving the study of hoisting and pumping engines, air compressors, blowing engines, fans, etc., and the Graphic Statics of Mechanisms, the Measurement of Power, Hydraulics, including hydraulic motors, and Electrotechnology, including the theory of electrical motors and dynamos and laboratory work in electrical measurements. The student is thus made acquainted with the principles involved in the design and construction of the buildings and machinery constituting a metallurgical plant and in the operation of the machines.

A thorough course is given in Physics, including laboratory work in mechanics and calorimetry.

In Chemistry, in addition to the training in chemical theory involved in the courses of Stoichiometry, Advanced Chemistry, and Chemical Philosophy, much time is devoted to work in the laboratory, involving the qualitative and quantitative analysis, both gravimetric and volumetric, of the more common ores and metallurgical products, including gas analysis and dry assaying. The student is thus made thoroughly familiar with the principles of the two chief sciences on which the operations of metallurgy are based and with the methods of analysis employed in the laboratories of smelting works.

Courses are given in Mineralogy and Blowpipe Analysis involving practice in the identification of crystals and of minerals by their physical properties and their behavior before the blowpipe. An elective course in Quantitative Blowpipe Analysis is open to these students.

A course in Petrology gives practice in the microscopic examination of rocks and is followed by courses in Historic, Dynamic and Economic Geology, and by two terms' work in the microscopic examination of rocks and of metallurgical materials.

A course in Ore Dressing renders the student familiar with the principles and methods of the mechanical preparation of ores and fuels.

The special instruction in Metallurgy is begun by a course in Metallurgical Construction. The class is taken on visits of inspection to neighboring metallurgical works. Each student makes sketches and takes notes on an assigned portion of the plant. From these working drawings are made and reports written describing and discussing the plant inspected. The student is thus rendered familiar with the furnaces and apparatus employed in metallurgical establishments, and with the methods in use in their drafting rooms. Courses of lectures in Metallurgy extend throughout the year. In these the chief weight is laid upon the chemical and physical principles involved in the various metallurgical processes. In order to impress these principles upon the mind of the student and to render their application familiar he is required to solve a series of problems which embody them. The problems are chiefly such as confront the metallurgist in his practice. In the course of Metallurgical Design the class is required to design a metallurgical plant to be operated under given conditions, a certain portion being assigned to each student. This involves calculations of stresses, weights and costs, the execution of working drawings and the discussion of the methods and apparatus chosen.

The metallurgical laboratory affords opportunity for special investigations in subjects connected with Metallurgy to such advanced students as are competent to conduct them, while laboratory work is regularly given which includes practice in the use of calorimeters and pyrometers, and exercise in the methods of investigation and measurement which a metallurgist should know how to conduct. The metallographic laboratory affords facilities for acquainting students with the newer methods of studying the physical properties of metals and alloys.

The proximity of the works of the Bethlehem Steel Company and the kindness of its officers, give opportunity for frequent visits of inspection by the students in classes and individually, and thus afford unusual facilities for the practical study of the metallurgy of iron and steel. In connection with the metallurgical laboratory, it is the practice to make investigations of the working efficiencies of furnaces in actual operation. Occasional visits of inspection are made to more distant works, in connection with the metallurgy of zinc, copper, lead, gold, and silver.

Graduates in this course receive the degree of Metallurgical Engineer (Met.E.).

THE COURSE IN METALLURGICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Plane Analytic Geom., (3)	144	Solid Analytic Geom., } (5)	145
Advanced Algebra, (2)	143	Differential Calculus, }	
Chemistry, (2)	390	Elem. Mechanics, (5)	321, 321a
Chemical Laboratory, (2)	391	German, (3)	95
German, (3)	94	*or* French, (3)	75
or French, (3)	74	Qualitative Analysis, (3)	393
Elementary Mechanics, (2)	320	Stoichiometry, (1)	394
English, (3)	120, 121, 125	English, (2)	122, 125
Freehand Drawing, (1)	155	Gymnasium, (2)	440
Mechanical Drawing, (2)	312		
Gymnasium, (2)	440		

SUMMER TERM

Constructive Elements of Machinery and of Electrical Apparatus, 201, 350.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Integral Calculus, (4)	145	Physics, (4)	323, 323a
Physics, (4)	322, 322a	Quantitative Analysis, (4)	399
Metallurgical Const., (3)	314	Advanced Chemistry, (3)	403
Quantitative Analysis, (3)	397	English, (3)	124, 126, 128
Chemical Philosophy, (3)	395	Drawing and Design, (4)	313
English, (2)	123, 126	Physical Education, (1)	442
Physical Education, (1)	442		

SUMMER TERM Mechanical Technology, 206.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Strength of Materials, (4)	172	General Metallurgy, (2)	245
Boilers, (1)	203	Metallurgy of Iron, (2)	246
Mineralogy, (5)	267	Metallurgical Probs., (1)	247
Blowpipe Analysis, (1)	268	General Geology, (2)	270
Assaying, (3)	414	Geological Lab., (2)	271
Quantitative Analysis, (3)	408	Hydraulics, (3)	177
Economics, (1)	16	Blowpipe Analysis, (1)	269
Physical Education, (1)	442	Steam Engine, (3)	205
		Economics, (1)	17
		Physical Education, (1)	442

SENIOR YEAR

FIRST TERM		SECOND TERM	
Metallurgy, (4)	251	Mech. of Machinery, (4)	227
Metallurgical Probs., (1)	252	Economic Geology, (3)	274
Ore Dressing, (2)	309	Electrometallurgy, (1)	255
Ore Dressing Lab., (1)	310	Metallurgical Design, (2)	243
Electrotechnology, (2)	372	Metallurgical Lab., (1)	253
Mech. of Machinery, (2)	207	Engineering Lab., (1)	222
Petrography, (2)	279	Petrography, (1)	280
Engineering Lab., (1)	221	Thesis, (6)	261
Metallography, (2)	258	Physical Education, (1)	442
Physical Education, (1)	442		

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN ELECTROMETALLURGY

This course is designed to prepare the student to enter the rapidly developing fields of electrometallurgy and electrochemistry.

For the first year the course is identical with that in Metallurgical Engineering, embracing fundamental instruction in mathematics, physics, drawing, and modern languages. In the last three years this course agrees with the Metallurgical Engineering course in the inclusion of Chemical Analysis, Chemical Philosophy, Mineralogy, Metallurgy, Ore Dressing, Boilers, Steam Engine, Measurement of Power and the general culture studies; it differs from it by devoting less time to assaying, by omitting certain courses in Civil and Mechanical Engineering, and by devoting the time thus gained to electrical and electrochemical subjects. The subjects thus introduced are Advanced Theory of Electricity and Magnetism, with practical work in measurement of current, resistance, electromotive force, inductive capacity, magnetic testing of iron, etc.; Theory of Direct and Alternating Current Dynamos and Motors, with experimental studies and tests, Electrical Generating Stations, Transmission and Receiving Systems; Theory of Electrochemistry and Principles of Electrometallurgical and Electrochemical Practice, with experimental studies and tests in the laboratory.

In the study of Electrochemistry particular attention is paid to the quantitative side of the subject, such as resistance of electrolytes, the energy requirements of the electrolytic cell, the applications of Faraday's laws to solutions and fused electrolytes, the influence of current density, concentration, diffusion and temperature on the nature of the products of electrolysis, the theory as developed in the lectures being illustrated in practice by each student in the electrochemical laboratory. Similarly, in Electrometallurgy the descriptions of the processes of extracting metals as given in the lecture room are illustrated by the student himself in the laboratory by measurements of energy requirements, current efficiencies, etc., of electrometallurgical methods. Towards the end of the term an electrometallurgical subject is given each student, to be investigated practically by him in the laboratory.

Graduates in this course receive the degree of Electrometallurgist (El.Met.).

THE COURSE IN ELECTROMETALLURGY

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Plane Analytic Geom., (3)	144	Solid Analytic Geom., } (5) Differential Calculus, }	145
Advanced Algebra, (2)	143	Elem. Mechanics, (5)	321, 321a
Chemistry, (2)	390	German, (3)	95
Chemical Laboratory, (2)	391	*or* French, (3)	75
German, (3)	94	Qualitative Analysis, (3)	393
or French, (3)	74	Stoichiometry, (1)	394
Elementary Mechanics, (2)	320	English, (2)	122, 125
English, (3)	120, 121, 125	Gymnasium, (2)	440
Freehand Drawing, (1)	155		
Mechanical Drawing, (2)	312		
Gymnasium, (2)	440		

SUMMER TERM Constructive Elements of Machinery and of Electrical Apparatus, 201, 350.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Integral Calculus, (4)	145	Physics, (4)	323, 323a
Physics, (4)	322, 322a	Drawing and Design, (4)	313
Chemical Philosophy, (3)	395	Quant. Analysis, (5)	399, 402
Quantitative Anal., (4)	397, 398	Advanced Chemistry, (3)	403
Metallurgical Const., (3)	314	English, (3)	124, 126, 128
English, (2)	123, 126	Physical Education, (1)	442
Physical Education, (1)	442		

SUMMER TERM Mechanical Technology, 206.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Strength of Materials, (4)	172	General Metallurgy, (2)	245
Mineralogy, (5)	267	Metallurgy of Iron, (2)	246
Blowpipe Analysis, (1)	268	Metallurgical Probs., (1)	247
Elec. and Magnetism, (2)	325	Blowpipe Analysis, (1)	269
Electrical Laboratory, (1)	326	Alternating Currents, (2)	357
Dynamos and Motors, (2)	354	Electrical Engineering, (2)	362
Boilers, (1)	203	Hydraulics, (3)	177
Economics, (1)	16	Electrical Laboratory, (1)	327
Physical Education, (1)	442	Dynamo Laboratory, (1)	355
		Steam Engine, (3)	205
		Economics, (1)	17
		Physical Education, (1)	442

SENIOR YEAR

FIRST TERM		SECOND TERM	
Metallurgy, (4)	251	Electrometallurgy, (1)	255
Metallurgical Probs., (1)	252	Electromet. Design, (2)	244
Ore Dressing, (2)	309	Electromet. Lab., (1)	257
Ore Dressing Lab., (1)	310	Metallurgical Lab., (1)	253
Engineering Lab., (1)	221	Blowpipe Analysis, (1)	260
Electric Stations, (2)	370	Engineering Lab., (1)	222
Dynamo Laboratory, (1)	356	Electric Power, (3)	375
Electrical Laboratory, (1)	328	Dynamo Laboratory, (2)	378
Electrochemistry, (1)	254	Thesis, (6)	262
Electrochemical Lab., (2)	256	Physical Education, (1)	442
Metallography, (2)	258		
Physical Education, (1)	442		

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN MINING ENGINEERING

The object of this course is to prepare the student for practice in the field of Mining Engineering. It is designed to give him not only the thorough training of an engineer, but also that broadness of education which enables him to readily undertake the great variety of propositions which naturally present themselves to one of his profession.

The course is therefore a very broad one, and when completed, it places him in the path of a great number of opportunities. Not only will he have had sufficient practice and training to enable him to enter upon the field of mining, but he can also readily take up work in chemistry, geology, metallurgy, electrometallurgy; and in chemical, civil, electrical, or mechanical engineering.

The principal objects in view, however, are that he may be enabled:—

First. To make surface and underground surveys, and to plot the same; also to map the topography and geology of a district.

Second. To analyze and treat substances encountered on a mining property, to value and report upon the same; and to analyze metallurgical products.

Third. To make mining, metallurgical or other designs to meet the requirements of given cases, and to enter upon the construction and take charge of the same.

Fourth. To take upon graduation a subordinate position as an engineer in connection with any of the previously mentioned lines of engineering.

In the Freshman year the time is practically devoted to laying a broad foundation in the fundamental subjects of English, Modern Languages, Mathematics and Physics, thus preparing the way for the technical and scientific studies of the following years. Lectures are given in Hygiene, and Gymnasium exercises under a competent director are required.

The course in Drawing begins, as soon as the student enters college, with freehand sketching of such subjects as bear upon future work. Parallel with the preceding is taught Mechanical Drawing, in which course he learns the use of drawing instruments, makes tracings and blue prints, solves problems in Descriptive Geometry, and in the Sophomore year makes drawings of machine parts of simple construction. In Metallurgical Construction he becomes familiar with metallurgical plants by frequent visits to those in the vicinity and by sketches and drawings of typical metallurgical furnaces and equipment elsewhere.

The Summer School in Constructive Elements of Machinery and of Electrical Apparatus gives the student the acquaintance with machine and electrical parts which is so necessary for every mining engineer. It is held at the close of the Freshman year, while the Summer Schools in Land and Topographic, Mine and Railroad Surveying, of four weeks each,—given at the close of the Sophomore and Junior years respectively,—enable the student to devote his entire time to each subject and the practical operations therein involved. The last of these three schools is conducted partly in the mining regions and not only gives him practice in mine and railroad surveying, but enables him to study mining operations and mining plants from which data are obtained exemplifying class room work as well as facilitating that in Mining Design.

The Course in Chemistry extends from the first term of the Freshman year to the middle of the Junior year. It begins with an introduction to general chemical theory and the elements,—supplemented by laboratory work; the subject is continued by qualitative and quantitative analysis and assaying; chemical problems and reactions are taught under Stoichiometry. The instruction includes the analysis, by standard methods, of common ores, fuels, gases and metallurgical products.

Mineralogy is introduced by a short course in Crystallography in which the student studies accurately made models of crystals; carefully selected mineral specimens are then thoroughly studied and the various means of identification are applied to more difficult examples, the determination of which may be assisted and effected by Blowpipe Analysis.

Biology gives an excellent training in the study of animal life. The study of living organisms, their structure, development, origin and distribution, is taken up in this course.

The importance of conservation of the timber resources of the country and the preservation of woods against decay are treated in Forestry. Following a brief introduction to Botany, the characteristics of the woods of the important timber species are given particular attention.

In the courses in Geology one learns the forms and structures of the rock masses of the earth's crust, and the forces which modify them. A brief review of historical geology follows, dealing with the fossil life of the earth and its application to the determination of the age of strata. Practice in Field Geology teaches him the methods by which rock formations are accurately

mapped. Economic Geology treats of the formation of cavities in rocks and their relation to ore deposits, together with the manner in which minerals have been deposited:—the structure, geographical horizon and distribution of the principal non-metallic and metallic mineral deposits are then taken up. The course in Petrography in the Junior year prepares the student to readily identify the common rock-forming minerals by means of the microscope, especially when the constituents are too fine grained to be determined by the eye alone. The grouping of these minerals into rock textures is then taken up and by laboratory and field practice the student learns to recognize the main types of rock.

In Boilers and Steam and Gas Engines the common types and accessories are fully treated; work in the Engineering Laboratory enables complete tests to be made upon the same, and their efficiencies and powers under varying conditions are calculated.

A thorough course in Strength of Materials treats of the theory and practice which govern the elasticity and strength of all forms of common materials which are used in constructions. Methods of computing and designing beams, columns, shafts, etc., and practical work in testing laboratory are prominent features of this course. Hydraulics treats of the flow of water through orifices, mains, pipes and channels, and also of the principles of hydraulic motors. The course in Graphic Statics gives the student the ability to analyze the forces which exist in roof trusses, beams and girders by the graphical method.

The instruction in Mining Engineering is given in a series of courses extending over the entire Junior and Senior years, under the following subdivisions: Prospecting, boring, mining, haulage and hoisting, drainage, ventilation, lighting and accidents treat successively of the steps by which minerals are discovered and valued, the manner in which they are extracted from the earth and brought to the surface, the means by which mines are maintained in an economical condition both from the standpoint of the mine owner and that of the miner, and finally the manner in which accidents may occur, the means for guarding against the same, and the treatment of injured persons. The subject of Ore Dressing, supplemented by work in the laboratory, treats of the processes by which ores or fuels, direct from the mine, are rendered marketable.

Mine and Railroad Construction and Mine Administration treat respectively of the materials used in roads and structures in and

around mines, and of the methods of employing labor, keeping accounts, and of management.

In Metallurgy, the general principles of the subject, embracing fuels, furnaces, and processes, are thoroughly presented, followed by the metallurgy of iron and steel, copper, lead, silver, gold, zinc, mercury, tin, nickel, and aluminum. Electrometallurgy familiarizes the student with the practical applications of electricity to metallurgical processes.

Electrotechnology, extending over the entire Senior year, embraces the study of the industrial applications of electricity which are of particular value to the mining engineer, and includes practical work in the Dynamo Laboratory.

In Mining and Metallurgical Design the student embodies the foregoing principles and makes designs and working drawings of plant to fulfill given conditions.

A course in Spanish for the benefit of those who purpose practicing their profession in Spanish-speaking countries, is offered as an extra study during the Senior year. It is a required study in the Geological Alternative.

The facilities for exemplifying the work of the course are almost unequalled. Numerous cement mills, cement, slate and other quarries, ore and coal mines, are within easy distance, while in the same town are the great works of the Bethlehem Steel Company. During the Junior and Senior years inspection trips, required of all students, are made to the anthracite regions and metal mining districts of eastern Pennsylvania and New Jersey, as well as to the metallurgical works of those districts.

For description of the Eckley B. Coxe Mining Laboratory, in which are contained the office and recitation rooms of the Department of Mining Engineering, as well as the ore dressing, assaying, chemical, surveying, and drilling equipment of the department, see page 133.

Each student is required to present a thesis on some topic bearing upon the work of the course, and while it is generally customary to select it from some subject connected directly with mining, geology, or metallurgy, it may be selected from subjects in other departments.

Graduates in this course receive the degree of Engineer of Mines (E.M.).

THE COURSE IN MINING ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Plane Analytic Geom., (3)	144	Solid Analytic Geom., Differential Calculus, (5)	145
Advanced Algebra, (2)	143		
Chemistry, (2)	390	Elem. Mechanics, (5)	321, 321a
Chemical Laboratory, (2)	391	Qualitative Analysis, (3)	393
Elementary Mechanics, (2)	320	Stoichiometry, (1)	394
German, (3)	94	German, (3)	95
or French, (3)	74	*or* French, (3)	75
Freehand Drawing, (1)	155	English, (3)	122, 125, 128
Mechanical Drawing, (2)	312	Gymnasium, (2)	440
English, (3)	120, 121, 125		
Gymnasium, (2)	440		

SUMMER TERM Constructive Elements of Machinery and of Electrical Apparatus, 201, 350.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Integral Calculus, (4)	145	Spherical Trig., (1)	142
Physics, (4)	322, 322a	Physics, (4)	323, 323a
Quantitative Analysis, (3)	397	Quantitative Analysis, (3)	399
Quant. Anal. Conf., (1)	398	Quant. Anal. Conf., (1)	402
Mineralogy, (5)	267	General Geology, (2)	270
Blowpipe Analysis, (1)	268	Geological Lab., (3)	271
Drawing and Design, (2)	313	Blowpipe Analysis, (1)	269
Physical Education, (1)	442	Drawing and Design, (4)	313
		Physical Education, (1)	442

SUMMER TERM Land and Topographic Surveying, 163, 166.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Mining Eng., (3)	300-302	Mining Eng., (5)	302-306
Metallurgical Const., (3)	314	General Metallurgy, (2)	245
Assaying, (3)	414	Metallurgy of Iron, (2)	246
Boilers, (1)	203	Metallurgical Probs., (1)	247
Strength of Materials, (4)	172	Economic Geology, (2)	272
Petrography, (2)	279	Steam Engine, (3)	205
Forestry, (3)	291	Hydraulics, (3)	177
Economics, (1)	16	Economics, (1)	17
Physical Education, (1)	442	Physical Education, (1)	442

SUMMER TERM Mine and Railroad Surveying, 311.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Ore Dressing, (2)	309	Mining Design, (3)	315
Ore Dressing Lab., (1)	310	Mine Administration, (1)	308
Mining Eng., (2)	307	Metallurgical Design, (2)	243
Metallurgy, (4)	251	Metallurgical Lab., (1)	253
Electrotechnology, (2)	372	Electrometallurgy, (1)	255
Dynamo Laboratory, (1)	355	Electrotechnology, (2)	379
Gas Engines, (2)	230	Dynamo Laboratory, (1)	356
Graphic Statics, (2)	173	Economic Geology, (3)	274
Engineering Lab., (1)	221	Engineering Lab., (1)	222
Field Geology, (2)	278	Thesis, (3)	316
Physical Education, (1)	442	Physical Education, (1)	442

The figures in parentheses indicate the number of exercises per week.

GEOLOGICAL ALTERNATIVE IN THE COURSE IN MINING ENGINEERING

The object of this alternative is to meet the recent demand of certain branches of mining engineering for additional training in geology and allied subjects.

The work of the mining engineer has of late years become divided into two rather distinct lines of work; in the one the engineer is essentially a resident engineer and remains in one general locality; in the other work he is especially concerned with mine examinations, reports on mining properties, etc., and travels about, remaining in a single locality only sufficiently long to thoroughly understand the geological features and the facilities which a property offers for development.

The resident mining engineer is called upon to superintend the operations of ore extraction and treatment and to generally direct the actual mining. His work, while it requires a very thorough knowledge of geology in order that he may be capable of conducting the underground development of the property, is more especially concerned with the civil, mechanical, and electrical engineering features of the work, such as the construction of mine plant, tipples, head-frames, equipment for ore extraction, cheapest methods of mining, ore dressing, treatment, etc. This is especially true of engineers employed in coal regions or localities where geological features are either simple or so thoroughly worked out and described as to offer no problems of special difficulty.

On the other hand, to the mining engineer who is chiefly occupied in the valuation of prospective mining properties or is called upon to superintend or open up deposits in remote localities, geology becomes a subject of paramount importance. An additional training in the geological examination of ore deposits is absolutely essential. A thorough knowledge of all available sources of published information on all parts of the country, and a working knowledge of structural features, distribution of geologic formations and general geological features of the North American continent are necessary.

There has been in addition to this kind of work, an increasing demand for a class of mining engineers usually designated as mining geologists, who shall be especially occupied in the detailed working out of the geological features of mining properties. Such men are now frequently retained as resident engineers in the employ of large mining companies, as well as by exploration companies in different parts of the world.

The geological alternative is designed to meet these several demands for the geological mining engineer. For the first two years the work in the courses is identical; in the Junior year the change is slight, being confined to an increase in Petrography and Physiography during the second term; in the Senior year the study of Paleontology and that of the Geology of North America are substituted for certain subjects given in the regular course. By means of these particular studies the engineer is trained in the thorough knowledge and understanding of the geological structure, distribution of rocks, and physiographic features of North America. He becomes familiar with the literature of geology, prepares plates and maps illustrating the areas covered by all principal geological surveys, and is in possession of the latest information of a geological nature on any part of the American possessions to which he may be called.

These courses are designed to be as little divergent as possible in view of the requirements, so that the training in either one of the alternatives, while preparing a man more specifically for one branch of the work, will not prevent him from undertaking the other with success.

GEOLOGICAL ALTERNATIVE

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Mining Eng., (3)	300-302	Mining Eng., (5)	302-306
Metallurgical Const., (3)	314	General Metallurgy, (2)	245
Assaying, (3)	414	Metallurgy of Iron, (2)	246
Strength of Materials, (4)	172	Metallurgical Probs., (1)	247
Petrography, (2)	279	Petrography, (1)	280
Biology, (3)	292	Hydraulics, (3)	177
Economics, (1)	16	Physiography, (2)	277
Physical Education, (1)	442	Economic Geology, (2)	272
		Economics, (1)	17
		Physical Education, (1)	442

SUMMER TERM Mine and Railroad Surveying, 311.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Ore Dressing, (2)	309	Mining Design, (3)	315
Ore Dressing Lab., (1)	310	Mine Administration, (1)	308
Mining Eng., (2)	307	Economic Geology, (3)	274
Metallurgy, (4)	251	Electrometallurgy, (1)	255
Electrotechnology, (2)	372	Electrotechnology, (2)	379
Dynamo Laboratory, (1)	355	Dynamo Laboratory, (1)	356
Graphic Statics, (2)	173	Geology of N. America, (3)	276
Field Geology, (2)	278	Spanish, (2)	110
Paleontology, (2)	275	Thesis, (3)	316
Spanish, (2)	110	Physical Education, (1)	442
Physical Education, (1)	442		

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN ELECTRICAL ENGINEERING

The object of this course is, first, to give a broad education in general and scientific subjects, and second, to give training in those special studies which are of most value in the equipment of the electrical engineer. The course includes a number of special studies in civil, mechanical and metallurgical engineering, and the graduate in Electrical Engineering is prepared, by the broad technical training which the course offers, not only to enter any of the branches of electrical engineering, but also to deal with the related problems in mechanical engineering, civil engineering and metallurgical engineering.

The fundamental studies in mathematics, physics, chemistry, and language, including English, are given in the early part of the course. These subjects include the more essential features of a broad education, and they furnish a preparation for the more advanced scientific and technical training to follow.

Electrotechnical work, begun early in the course during the summer term at the end of the Freshman year, is continued through the Sophomore year in the study of Electric Wiring, and Dynamos and Motors (with Dynamo Laboratory). The Junior and Senior years are devoted almost exclusively to advanced technical work. Two terms of Economics are required during the Junior year, followed by a short course in Business Law during the first term of the Senior year.

The study of Electricity and Magnetism during the first term of the Sophomore year constitutes an introduction to the industrial applications of electricity.

The subject of Electric Wiring, begun the first term of the Sophomore year, makes immediate application of electrical theory to the calculation of lighting and power circuits, the testing of insulation resistance, and similar problems. This study also includes the installation and wiring of electrical machinery, systems of electrical distribution, outside and interior wiring, and the rules for wiring prescribed by the Fire Insurance Underwriters.

The study of Dynamo Electric Machinery is begun the second term of the Sophomore year, and includes electrodynamics, the construction, operation and control of direct current generators and motors, with numerous illustrative problems. This subject is continued during the first term of Junior year and is resumed during the first term of the Senior year under the name Alternating Current Machinery, which deals with alternators, single-

phase and polyphase motors, synchronous converters, transformers, and other apparatus.

The following special subjects in Mechanical Engineering are required in this course: Machine Design, begun in the first half of the Sophomore year, is continued for one year. Constructive Elements of Machinery is given in the summer term at the end of the Freshman year in conjunction with the work in Constructive Elements of Electrical Apparatus. Boilers, given during the first term of the Junior year, is followed by Steam Engine, during the second term of the Junior year. Mechanical Technology is given in the summer term at the end of the Sophomore year. This is a course in shop instruction intended principally to familiarize the student with the processes involved in patternmaking, moulding, forging, fitting and finishing. Frequent visits of inspection are made to manufacturing establishments in the vicinity. Following the work in Mechanical Technology, the study of Mechanics of Machinery is pursued during the first term of the Junior year and Engineering Laboratory is given throughout the Senior year. The latter subject includes the calibration of engineering measuring instruments and the performance of practical tests on boilers, engines, and pumps.

The following special studies in Civil Engineering are included in this course: Strength of Materials, given in the first term of the Junior year, is concerned with the theory of beams, columns and shafts, and the method of computing and designing them; the subject includes practical work in the testing laboratory; Hydraulics, including laboratory practice, given in the second term of the Junior year, treats of hydrostatics and theoretical hydraulics, the flow of water through orifices, weirs, pipes, and channels, naval hydromechanics, and hydraulic motors. Land Surveying, with special reference to location of electric railways, may be taken as an option in the second term of the Junior year.

The study of general Metallurgy and Metallurgy of Iron and Steel is elective during the second term of the Junior year. Lectures given one hour per week on Electrochemistry and Electrometallurgy are given as extras during the Senior year.

The special studies in Electrical Engineering which come after Electric Wiring, Dynamos and Motors, and Electricity and Magnetism of the Sophomore year include the following:

Advanced Theory of Electricity and Magnetism, begun in the first term of the Junior year. is devoted to the theory of electrical

units and measurements, and to the advanced theory of electrostatics and the magnetism of iron. The accompanying laboratory work is devoted to precise electrical measurements, and the standardization and calibration of electrical measuring instruments. The Theory of Alternating Currents is also begun with the Junior year and is pursued up to the middle of the Senior year; this subject deals with the problems and methods of measurement which are peculiar to the modern practical applications of alternating currents, and with the theory underlying the action of the important types of alternating current machinery and transmission lines.

The subject of Electrical Engineering, beginning in the second term of the Junior year and following as it does the study of Dynamo Electric Machinery, deals with the distribution and utilization of electric power, comparison of systems, feeder regulation, arc and incandescent lighting.

Dynamo laboratory work, beginning in the second term of the Sophomore year, is continued for five terms. The instruction given by a laboratory manual is supplemented by individual direction and supervision in the laboratory. The students work individually or in pairs, and make the more important tests on direct and alternating current generators and motors, rotary converters, transformers, and other electrical apparatus. Carefully written reports of all tests made, with curves plotted from the observations, and discussions of results, are required.

Dynamo Electric Machinery, as already stated, is continued from the Sophomore year through one term of each of the Junior and Senior years. Special attention is paid to the application of electric and magnetic theory to the construction and operation of different types of direct and alternating current machinery.

The Electrical Engineering Seminary continues throughout the Senior year. The work consists of the presentation before the class of papers on assigned topics, supplementing the regular work of the class-room, and of reports on thesis work. The Department reading-room is well supplied with the leading electrical periodicals, American and foreign, and one of the principal objects of the Seminary work is to encourage the systematic reading of the current engineering journals. Reports on articles in the technical French and German periodicals are included as part of the work of the Seminary.

Dynamo Testing is given by lectures and problems beginning with the second term of the Junior year, and continuing through

the first term of the Senior year. It treats of standard and special methods of making tests on dynamo machines, transformers, and other electrical apparatus. Most of the methods discussed in the lectures are exemplified by the practical testing done in the dynamo laboratory.

Electric Stations, given in the first term of the Senior year, constitutes an extension of the preliminary work given as Electrical Engineering during the second half of the Junior year. Under this subject are discussed the location, design, and equipment of stations; the selection of suitable prime movers, generators, switchboards, and other apparatus. The use and operation of storage batteries, boosters and other auxiliaries, also receive consideration.

Electric Traction and Power Transmission are both given during the second term of the Senior year. Under Electric Traction are studied the construction, equipment and operation of different types of electric railways. The recent developments in the application of electric motive power to steam railroad conditions are discussed, and the results of tests analyzed. Practice is given in the estimating of the probable cost of building and operating an electric railway to fulfill certain specific conditions.

The subject of Electric Power Transmission deals with the various elements constituting a transmission system. It includes a study of the generating plant, the transmission line, and the receiving systems. Special attention is given to the design, construction, and protection of the line. Under the last three subjects are included visits of inspection to electric light and power stations, and to manufacturing establishments in the Bethlehems and out of town. Central station tests are made and reports required. Electrical Design is begun in the first term of the Senior year and is pursued throughout the year. The work consists of a series of problems illustrating the application of electromagnetic laws to the calculation and proportioning of electrical machinery for a special duty. Each student makes calculations for several types of apparatus, such as electromagnets, direct and alternating current generators and motors, and transformers. The study of electrical design is intended to reenforce by concrete application the principles underlying the study of dynamo electric machinery.

Graduates receive the degree of Electrical Engineer (E.E.)

THE COURSE IN ELECTRICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Plane Analytic Geom., (3)	144	Solid Analytic Geom., } (5)	145
Advanced Algebra, (2)	143	Differential Calculus, }	
Chemistry, (2)	390	Elem. Mechanics, (5)	321, 321a
Chemical Laboratory, (2)	391	Qualitative Analysis, (3)	393
Elementary Mechanics, (2)	320	Stoichiometry, (1)	394
German, (3)	94	German, (3)	95
or French, (3)	74	*or* French, (3)	75
Freehand Drawing, (1)	155	English, (2)	122, 125
English, (3)	120, 121, 125	Gymnasium, (2)	440
Gymnasium, (2)	440		

SUMMER TERM Constructive Elements of Machinery and of Electrical Apparatus, 201, 350.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Integral Calculus, (4)	145	Differential Equations, (1)	146
Physics, (4)	322, 322a	Analytic Mechanics, (2)	147
Draw'g and Mach. Des., (3)	200	Physics, (4)	323, 323a
Elem. Mech. Materials, (1)	185	Machine Design, (3)	202
Electric Wiring, (1)	351	Dynamos and Motors, (3)	352
French, (3)	70	Dynamo Laboratory, (1)	353
or German, (3)	90	French, (3)	73
English, (3)	123, 126, 128	*or* German, (3)	91
Physical Education, (1)	442	English, (2)	124, 126
		Physical Education, (1)	442

SUMMER TERM Mechanical Technology, 206.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Theory of Alt. Cur., (2)	357	Electrical Engineering, (1)	361
Elec. and Magnetism, (2)	325	Dynamo Testing, (1)	366
Dynamo Elec. Mach'y, (2)	358	Theory of Alt. Cur., (2)	360
Dynamo Laboratory, (1)	359	Electrical Laboratory, (1)	327
Electrical Laboratory, (1)	326	Dynamo Laboratory, (1)	363
Boilers, (1)	203	Hydraulics, (3)	177
Strength of Materials, (4)	172	Hydraulic Laboratory, (1)	187
Mech. of Machinery, (2)	207	Steam Engine, (3)	205
Testing Laboratory, (1)	186	Economics, (1)	17
Economics, (1)	16	Metallurgy, (3)	348-250
Physical Education, (1)	442	*or* Land Surveying, (3)	164
		Physical Education, (1)	442

SUMMER TERM Electrical Engineering Inspection, 380.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Electrochemistry, (1)	254	Electrical Design, (3)	373
Alt. Current Mach., (5)	365	Power Transmission, (3)	375
Electrical Design, (2)	369	Electric Traction (3)	374
Electric Stations, (2)	370	Dynamo Laboratory, (2)	377
Dynamo Laboratory, (2)	368	Engineering Lab., (1)	222
Dynamo Testing, (1)	367	Electrical Seminary (1)	376
Electrical Seminary, (1)	371	Electrometallurgy, (1)	255
Engineering Lab., (1)	221	Thesis, (3)	381
Advanced Elec. Lab., (1)	328	Physical Education (1)	442
Business Law, (1)	20		
Physical Education, (1)	442		

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN CHEMISTRY

This course of study is designed to prepare students for the profession of chemist, in connection with metallurgical establishments, sugar refineries, gas works, manufacturing works, chemical plants, electrical machinery manufactories, mining companies, etc., and the general consulting and analytical work of the professional chemist. It is also well adapted to the preparation of teachers of chemistry, research chemists, and as a course preliminary to the study of medicine.

With these objects in view, the instruction is of such a character as to emphasize the great importance of accurate work, to teach the student to make careful observations and deductions, to develop scientific habits of thought, as well as to give him a knowledge of the principles and facts of chemistry. The instruction is eminently practical, a large portion of it being devoted to laboratory work during the four years necessary to complete the course.

Instruction in Theoretical Chemistry is begun in the first term of the Freshman year, with laboratory work in general inorganic chemistry. Stoichiometry, with practice in chemical problems, is taught in the second term of the Freshman year and is followed in the Sophomore year by Chemical Philosophy and Advanced Chemistry. In both terms of the Junior year there is a course of lectures and recitations on Organic Chemistry, with laboratory work.

Qualitative Analysis is taught by lectures and laboratory work in the second term of the Freshman year. This is followed by courses in Quantitative Analysis throughout the Sophomore and first term of the Junior year. This course includes Gas Analysis. Furnace Assaying and the assay of gold and silver bullion are taught in the first term of the Junior year by lectures and laboratory work. Instruction is given in Industrial Chemistry, through the first and second terms of the Senior year. The analysis of various commercial products is taken up in the second term of the Senior year, also the subject of Sanitary Chemistry. Blowpipe Analysis is included in the course.

The laboratory practice in Organic Chemistry is continuous through the Junior year in the organic laboratory. Physical Chemistry is taught by lectures, text-book and laboratory work. In the Senior year the student prepares a thesis on some chemical subject, involving laboratory work.

The laboratory for qualitative analysis is a large, well-ventilated and well-lighted room, supplied with convenient working tables, vacuum filtration, hoods for noxious vapors, steam baths, gas and washing appliances, and a commodious room for hydrogen sulphide. Distilled water is delivered by faucet in this room and other large laboratories.

The quantitative laboratory is equipped like the qualitative laboratory, but is supplied in addition with apparatus for drying precipitates and residues, rooms for the chemical balances, for combustions, and for a reference library.

The gas laboratory is supplied with full and complete apparatus for gas analysis, according to Orsat's, Hempel's, and Bunsen's processes.

The assaying laboratory is supplied with large working tables, twenty-nine crucible and two iron furnaces, and eight muffle furnaces, with adjoining rooms for balances, and gold and silver bullion analysis.

The laboratory for organic chemistry is equipped similarly to the quantitative laboratory, in addition being supplied with high pressure steam, cold water and air blast upon the working tables, and a full supply of apparatus for the various determinations and experiments, including combustion furnaces, furnaces for heating sealed tubes, Hofmann's, Dumas's, and Meyer's apparatus for vapor densities, other physico-chemical apparatus, nitrometers, chemical balances, etc.

The working laboratories for industrial chemistry contain an apparatus for making illuminating gas, for wood products, an alcohol still, worm and doubler, and a complete working model of sugar refinery, including filters, vacuum pan, and centrifugal. There is also apparatus for use in the manufacture of chemicals, for dyeing, calico printing, and bleaching. In connection with these laboratories is a room containing a photometer and apparatus for determining the sulphur, ammonia, and specific gravity of illuminating gas; also a laboratory for the testing of alcoholic liquors, sugar, molasses, bone black, soap, petroleum, paints, dyes, superphosphates, tallow, illuminating and lubricating oils, rubber, explosives, asphalts, and other commercial products, with the necessary technical apparatus. The students make practical experiments in this direction, and, with an instructor, visit various industrial establishments in the neighborhood, in Philadelphia and in New York City. Bacteriology includes a course of lectures and laboratory work.

Graduates in this course receive the degree of Bachelor of Science (B.S.) in Chemistry.

THE COURSE IN CHEMISTRY

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Plane Analytic Geom., (3)	144	Solid Analytic Geom., Differential Calculus, (5)	145
Advanced Algebra, (2)	143		
Chemistry, (2)	390	Qualitative Analysis, (3)	393
Chemical Laboratory, (2)	391	Stoichiometry, (1)	394
Elementary Mechanics, (2)	320	Elem. Mechanics, (5)	321, 321a
German, (3)	94	German, (3)	95
or French, (3)	74	*or* French, (3)	75
Freehand Drawing, (1)	155	English, (3)	122, 125, 128
Mechanical Drawing, (2)	312	Gymnasium, (2)	440
English, (3)	120, 121, 125		
Gymnasium, (2)	440		

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Integral Calculus, (4)	145	Physics, (4)	323, 323a
Chemical Philosophy, (3)	395	Quantitative Analysis, (6)	400
Quantitative Analysis, (5)	396	Quant. Anal. Conf., (2)	402
Quant. Anal. Conf., (1)	398	Advanced Chemstry, (3)	403
Physics, (4)	322, 322a	English, (2)	124, 126
English, (2)	123, 126	Physical Education, (1)	442
Physical Education, (1)	442		

SUMMER TERM Assaying, 414.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Mineralogy, (5)	267	Organic Chemistry, (4)	411
*Quantitative Analysis, (4)	405	Organic Chem. Lab., (4)	412
Quant. Anal. Conf., (2)	407	General Metallurgy, (2)	245
Organic Chemistry, (3)	409	Metallurgy of Iron, (2)	246
Organic Chem. Lab., (2)	410	Metallurgical Probs, (1)	247
Blowpipe Analysis, (1)	268	General Geology, (2)	270
Physical Education, (1)	442	Geological Lab., (3)	271
		Blowpipe Analysis, (1)	269
		Physical Education, (1)	442

SENIOR YEAR

FIRST TERM		SECOND TERM	
Physical Chemistry, (3)	420	Industrial Chemistry, (3)	416
Physical Chem. Lab., (1)	421	Industrial Analysis, (3)	417
Metallurgy, (4)	251	Indus. Anal. Conf., (1)	418
Metallurgical Probs., (1)	252	Sanitary Chem. Lab., (3)	419
Industrial Chem. Lab., (3)	413	Electrometallurgy, (1)	255
Bacteriology, (2)	296	Electromet. Lab., (1)	257
Electrochemistry, (1)	254	Economics, (2)	17
Electrochemical Lab., (1)	256	Thesis, (3)	422
Economics, (2)	16	Physical Education, (1)	442
Physical Education, (1)	442		

The figures in parentheses indicate the number of exercises per week.

*Optional courses in Advanced Quantitative Analysis will be offered from year to year to students properly qualified. For 1916-1917 the course embraces the analysis of Ferro-alloys and the analysis of complex copper slimes.

THE COURSE IN CHEMICAL ENGINEERING

This course of study is designed to prepare students for the profession of the chemical engineer, engaged in the construction and management of manufacturing establishments involving chemical principles, such as sugar refineries, gas works, superphosphate works, bleacheries, dye works, oil refineries, fertilizer works, soap works, sulphuric acid plants, soda works, chemical plants, metallurgical works, etc.

In addition to many of the subjects in the Course of Chemistry, (which see,) it includes the subjects of boilers, steam engine, drawing and machine design, constructive elements of machinery, measurement of power, mechanics of machinery, and work in the engineering laboratory. It also includes advanced courses in electricity and magnetism, dynamos and motors, and work in the electrical and dynamo laboratories.

On the other hand, this course contains less laboratory work in quantitative analysis than does the course in Chemistry, and it omits the special instruction in blowpipe analysis. The courses in mineralogy and geology are also much less extensive. Should a student desire to gain a greater knowledge of these or other subjects it is possible, under certain conditions, for him to do so, but he will not be allowed to take up the study of any subject not in the course in Chemical Engineering if he has failed to pass the examinations in any of the required subjects in this course.

The Summer Schools following the Freshman, Sophomore and Junior years are a required part of the course.

In this course the training is essentially chemical and the graduates are primarily chemists with a good knowledge of mechanical and electrical engineering, and with additional training in the special mechanical and electrical appliances of industrial chemistry.

This equipment is considered more valuable for the chemical engineer than a fundamental training in engineering and a somewhat limited knowledge of chemistry, since the problems of the manufacturing chemist are not essentially mechanical ones. Although six years' work covering most of the studies of both the chemical and mechanical courses would be found advantageous for the chemical engineer, this shorter course, of four years, will meet the usual requirements.

Graduates of this course receive the degree of Chemical Engineer (Ch.E.).

THE COURSE IN CHEMICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Plane Analytic Geom., (3)	144	Solid Analytic Geom., } (5)	145
Advanced Algebra, (2)	143	Differential Calculus, }	
Chemistry, (2)	390	Elem. Mechanics, (5)	321, 321a
Chemical Laboratory, (2)	391	Qualitative Analysis, (3)	393
Elementary Mechanics, (2)	320	Stoichiometry, (1)	394
German, (3)	94	German, (3)	95
or French, (3)	74	*or* French, (3)	75
Freehand Drawing, (1)	155	English, (3)	122, 125, 128
English, (3)	120, 121, 125	Gymnasium, (2)	440
Gymnasium, (2)	440		

SUMMER TERM Constructive Elements of Machinery and of Electrical Apparatus, 201, 350.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Integral Calculus, (4)	145	Advanced Chemistry, (3)	403
Chemical Philosophy, (3)	390	Quantitative Analysis, (4)	399
Quantitative Analysis, (3)	397	Quant. Anal. Conf., (1)	402
Physics, (4)	322, 322a	Steam Engine, (4)	204
English, (2)	123, 126	Machine Design, (3)	202
Draw. and Mach. Des., (3)	200	Physics, (4)	323, 323a
Elem. Mech. Materials, (1)	185	Physical Education, (1)	442
Physical Education, (1)	442		

SUMMER TERM Assaying and Industrial Mineralogy, 415.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Quantitative Analysis, (2)	405	Organic Chemistry, (4)	411
Quant.Anal.Conference, (2)	407	Organic Chem. Lab., (4)	412
Organic Chemistry, (3)	409	General Metallurgy, (2)	245
Organic Chem. Lab., (2)	410	Metallurgy of Iron, (2)	246
Engineering Lab., (2)	208	Metallurgical Probs., (1)	247
Elec. and Magnetism, (2)	325	Engineering Lab., (1)	209
Dynamos and Motors, (2)	354	Electrical Engineering, (2)	362
Dynamo Laboratory, (1)	355	General Geology, (2)	270
Boilers, (1)	203	Dynamo Laboratory, (1)	356
Economics, (2)	16	Economics, (1)	17
Physical Education, (1)	442	Physical Education, (1)	442

SUMMER TERM Engineering Laboratory, 212.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Physical Chemistry, (3)	420	Industrial Chemistry, (3)	416
Physical Chem. Lab., (1)	421	Industrial Analysis, (3)	417
Industrial Chem. Lab., (3)	413	Indus. Anal. Conf., (1)	418
Metallurgy, (4)	251	Sanitary Chem. Lab., (3)	419
Metallurgical Probs., (1)	252	Electrometallurgy, (1)	255
Bacteriology, (2)	296	Electromet. Lab., (1)	257
Engineering Lab., (1)	220	Thesis, (3)	422
Mech. of Machinery, (2)	207	Physical Education, (1)	442
Electrochemistry, (1)	254		
Electrochemical Lab., (1)	256		
Physical Education, (1)	442		

The figures in parentheses indicate the number of exercises per week.

LIST OF STUDIES

Following is a complete list of studies offered by the University in its various courses. The number of exercises per week in each subject is indicated by the figures in parentheses. Two hours of drawing, three of work in the laboratory or three of practice in the field are regarded as equivalent to a recitation or lecture of one hour's duration.

UNDERGRADUATE COURSES

PHILOSOPHY, PSYCHOLOGY, AND EDUCATION

PROFESSOR HUGHES

Psychology

1. General Psychology. Major's Elements of Psychology, with laboratory. First term (2).

2. General Psychology, continued. Emphasis on educational standpoint. Assigned Readings. Second term (2).

3. Genetic Psychology. The development in the individual and in the race of play and sport, of the different forms of art, of the moral consciousness, and of the religious attitude. First or second term (2).

5. Psychological Topics. Open to all students of the University. First and second terms (1).

6. Experimental Psychology. First and second terms (1 or more).

Philosophy

7. History of Philosophy, Ancient. Special emphasis on Plato's Republic. First term (2).

8. History of Philosophy, Modern. The study of selected philosophical essays. Second term (2).

9. Scientific Method. Formal logic, followed by practice in presenting and criticising arguments. Open to Sophomores, Juniors and Seniors. First or second term (2) or (3).

Education

10. History of Education. Recitations. Graves. Second term (3) or with practice teaching (4).

11. Class Management. Strayer. Recitations and observations. Second term (2) or with practice teaching (3).

12 and 13. Principles and Practice of Teaching. Parker. Recitations and observations. First and second term (2) or with practice teaching (3).

14. Practice Teaching. This may be done either in the Lehigh Evening School or in the public or private schools of the Bethlehems and Easton. Credit will be given at the rate of one term hour for every twenty hours of observation and practice, provided adequate reports are handed in by the student to this department. Every student who has completed courses 1 and 2 (General Psychology), 10 and 11 (Junior Education), and who is now taking course 12 or 13 (High School Education), will be given an opportunity to observe or practice teaching for a period not to exceed three entire weeks or sixty hours of actual observation and practice each term. Arrangements must be made for this observation and practice at the commencement of each term, and the student's roster then adjusted to the amount of such work as is proposed.

Science and Scientists

15. Science and Scientists. This course consists of lectures by several members of the Faculty and assigned readings, treating of the several fields of science, their methods of study, their beginnings and results, with some description of the lives of great scientists and their work. First term (1).

ECONOMICS AND PUBLIC LAW

PROFESSOR STEWART, MR. BOWEN, MR. BICKLEY

16. Economics. A study of the elementary principles of political economy. Lectures and required reading in selected works. First term (3), (2) or (1).

17. Economics. Practical economic problems: taxation, transportation, finance, labor, trusts and monopolies. Second term (3), (2) or (1).

18. Economics. Finance. Discussion of public expenditures; their nature, their relation to the industrial, political, and social conditions; their relation to the functions of government; also discussion of financial organization and administration. First term (3).

19. Economics. Finance. Discussion of public revenues; of revenue derived from the public domain and public industries; the apportionment, classification, and administration of taxes;

the nature and employment of public credit; the origin and growth of public debts. Second term (3).

20. Economics. Elements of Business Law. The principles of contract; formation of contracts; operation and discharge of contracts; sales of goods; insurance contracts; negotiable instruments. First term (2) or (1).

21. Economics. Elements of Business Law. Principal and agent; master and servant; business associations; partnerships and corporations. Second term (2) or (1).

22. Constitutional Law. The constitutional framework and the practical operation of the Federal and State governments. The relation of government to the business and social interests of the people. Interpretation of the Constitution by the various departments of the government. Comparison of American and European practice. Given in 1916-1917. First and second terms (3).

23. International Law. The development of international law: its origin and history; economic and political changes determining the development of international relations; the Jus Gentium of the Roman Law and the "Natural Law" jurists. Law of Peace and War: general principles governing the normal relations of states and their relations in time of war. The Law of Neutrality, with special reference to the contributions of the United States; problems associated with blockade, contraband of war, unneutral service. Given in 1916-1917. First and second terms (3).

24. American Foreign Relations. Studies in the diplomatic relations of the United States with the main countries of Europe, with the Near East and the Far East. Omitted in 1916-1917. First term (3).

25. United States and Latin America. Problems arising out of the relations of South American States to one another and to the United States. Origin, development and application of the Monroe Doctrine. Omitted in 1916-1917. Second term (3).

26. Principles of Accounting. Sole proprietorship, partnership, single entry, profit and loss in single entry, profit and loss in double entry, trial balance, balance sheet, statement of profit and loss, use of columnar books, and controling accounts with subordinate ledgers. First term (3).

26a. Principles of Accounting. Corporation accounting, special books required in corporation accounting, legal requirements, opening corporate books and special entries, method of handling

stock, adjustment entries, profits, dividends, closing of books, balance sheet, statement of profit and loss. Second term (3).

26b. Blue Print Reading. The course is designed to show the relation between the print and the concrete object it represents. A study will be made of various prints ranging from those of the simplest forms of tools and constructions to those of more complex form. First and second terms (1).

27. Economic Geography of North and South America. Physical features, climate, and resources of the Western Hemisphere. Their influence upon the economic, political, and social institutions. Particular attention is given to the present and prospective commercial relations of the United States with Mexico, Central and South America. First and second terms (3).

27a. Economic Geography of the Eastern Hemisphere. Physical features, climate, and resources of the Eastern Hemisphere. Their influence upon the economic, political, and social institutions. Emphasis is put upon the study of Great Britain, Germany, Russia, China, Japan, India, and the Philippine Islands. The present and prospective commercial relations of these countries with the United States. First and second terms (3).

28. Railroad Administration. This course considers from the administrative standpoint railways as factors in the social and industrial development of the United States. It treats of the historical and the geographical conditions of railroad location. The organization of railroads, considering charters and franchises, capital stock, directors and stockholders. The financial and legal aspects of these organizations, and their relation to the public through commissions. First and second terms (3).

29. Labor Legislation. Labor problems confronting the employer and the more successful methods of meeting them and avoiding legal disputes. The legal status of unions and strikes. Protection of the employer's interests. Employers' Liability and Workmen's Compensation Acts. First and second terms (2).

30. Industrial Management. Practical problems confronting the industrial manager. Factors determining the location of industry. Nature of plant structure and arrangement of process. Methods of wage payment. The human element in industry. First and second terms (2).

32. Investments. A comparative study of investment values (including bonds, stocks, notes, and mortgages) and the conditions affecting the investment market; with the emphasis on the

securities of corporations as investments. First and second terms (3).

32a. Statistics. Statistical method and applied statistics. Practice is given in the handling and especially in the interpretation of statistics. As much research as possible is carried on. First and second terms (3).

33. Banking and Currency. A study of the banking system of the United States, comparing it with those of the important European States, together with a study of the currency and currency problems of this country. Special emphasis is laid upon the Federal Reserve Act, loans and discounts, foreign exchange, and factors affecting the money market. First and second terms (3).

HISTORY

PROFESSOR STEWART, DR. HOEKSTRA

35. History of Europe in the Nineteenth Century. The narrative history of the period will be followed, with special emphasis on such topics as the political and economic reconstruction of Europe after the Napoleonic Wars, the revolutionary movements of 1848, the rise of Socialism, the unification of Italy and Germany, the agrarian problem in Russia and the Balkan problem. First and second terms (3).

36. The Political and Constitutional History of the U. S. Prior to 1860. The era of constitution making, State and Federal. Rise and growth of party government. The development of nationality and democracy. Political and constitutional questions arising in connection with internal improvements, the tariff, the bank and slavery. First and second terms (3).

37. Political and Constitutional History of the U. S. since 1860. A continuation of preceding course. Given alternately with course 36. First and second terms (3).

38. Industrial History. Special attention is directed to the evolution of modern industrial conditions as found in the growth of the economic powers of Great Britain, Germany and the United States. First and second terms (2).

LANGUAGES

LATIN

PROFESSOR BLAKE

40. Livy. Selections from the books covering the war with Hannibal. Particular attention to forms and the usages of normal syntax. Writing of Latin prose exercises chiefly based upon the

selections read. Written translations from Latin into English. History of the struggle between Rome and Carthage. Freshman, first term (3).

41. Horace. Odes and Epodes. Insistence upon tasteful translation. Constant practice in metrical reading. Memorizing of some of the odes of Horace. Writing of brief original dissertations on topics assigned in connection with Horace. Historical review of Roman lyric and elegiac poetry. Freshman, second term (4).

42. Cicero. De Senectute and De Amicitia, together with Latin prose exercises. Freshman, second term (1).

43. Pliny. Selected letters. Tacitus. Agricola and Germania. Consideration of social and legal usages suggested by Pliny. Some study of Roman provincial administration. Sophomore, first term (3).

44. Plautus and Terence. Careful study of a play of each, with rapid reading of as much more as the time permits. Study of dramatic verse-structure and practice in metrical reading. History of the drama at Rome. Sophomore, second term (3).

45. Tacitus. Selections from the Histories or Annals. Some consideration of Tacitus as an historian and a literary artist. Sight-reading from Suetonius. Junior or Senior, first term (3).

46. Juvenal. Selected Satires. Selections from Martial. Satire and epigram in Roman literature. Study of social conditions under the empire as evidenced by the writings of the younger Pliny, Tacitus, Suetonius, Juvenal, and Martial. Writing of brief dissertations on assigned topics. Junior or Senior, second term (3).

47. Lucretius. Careful study of one book entire of De Rerum Natura, with reading of selections from the other books. Consideration of textual questions. Discussion of ancient materialistic theories. Some review of Roman philosophy and ethics. Junior and Senior, second term (3).

48. Roman Law. An elementary course. Selections from the Institutes of Justinian, or Gaius, are read and commented on. Brief survey of Roman constitutional history and the development and content of the body of Roman Law, in connection with Morey's outlines of Roman Law. Junior or Senior, first term (3).

Reading for honors. Candidates for honors in Latin are assigned readings for the summer vacations, usually the Satires and Epistles of Horace, or selections from Ovid and Virgil and

collateral reading in the Sophomore vacation; the assignments for the Junior vacation are varied.

GREEK

PROFESSOR GOODWIN

50. Lysias. Selected Orations; or Xenophon. Memorabilia. Review of the Grammar. Attic prose syntax is carefully studied, and special attention given to the formation of correct methods of study and translation, to grammatical analysis, and the reading aloud of Greek. Available time is employed in sight-reading. Herodotus One book (begun). One hour a week for the greater part of the term is devoted to Prose Composition and a variety of practical exercises. First term (4).

51. Herodotus (continued). Study of the forms and syntax of the Ionic dialect. Plato. Euthyphro and Apology, or other shorter dialogues. Introduction to Greek Philosophy. Grammar and Composition as in the first term. Second term (4).

52. Thucydides. One or more books. Practical exercises, including composition, are given usually once in two weeks. First term (3).

53. Tragedy. Euripides. Medea, Bacchae, or another play. Sophocles. Oedipus Tyrannus, Antigone, or another. Literary study of the drama. Poetical language, style, and conception. Metrical reading. Composition from time to time. Second term (3).

54. Dramatic Poetry (continued). Aeschylus. Agamemnon, or Prometheus Bound. Aristophanes. Clouds, Frogs, or Birds. Aristotle. Chapters from the Poetics. Aristophanes as humorist and as moralist, with consideration of the tendencies which he satirized. Metres. Elementary text-criticism. First term (3).

55. Greek Oratory. Jebb's Selections from the Attic Orators. Demosthenes. Selected Orations. The reading is rapid, and the student is supposed to have reasonable facility in understanding the Greek directly without rendering into English. Attention is directed largely to those points which illustrate the development of Greek prose style. Second term (3).

56. Homer. Considerable portions of the Iliad or Odyssey are rapidly read. Homeric language, syntax, and metre are reviewed, with some reference to the needs of intending teachers, but chiefly as a foundation for the study outlined in course 57. First term (3).

57. Lyric Poetry. Fragments of the Elegiac, Iambic, and Melic Poets. Selections from Pindar, or Theocritus. Study of the development of poetry in Greece. Second term (3).

58. Hellenistic Greek. New Testament. Selections from Lucian. To be substituted on occasion for 57. Second term (3).

Courses 54 and 56, 55 and 57 are given in alternate years, and are open to both Juniors and Seniors.

Candidates for honors in Greek will be assigned special readings on request.

59. Elementary Greek. This course is offered in alternate years to Freshmen or Sophomores who have entered without Greek, but desire to take up the study in college. They perform in two years approximately the amount of work required for admission from those who present Greek, and are prepared to proceed in the third year with Course 50. The introductory book and a small portion of the Anabasis are studied in the first two terms. Given in 1915-16; omitted in 1916-17. First and second terms (4).

60. Elementary Greek, second year. Anabasis continued; Iliad; Grammar and simple Composition. Omitted in the years in which the preceding course is given. First and second terms (3).

FRENCH

PROFESSOR FOX, MR. TOOHY, MR. CHANDLER

70. Elementary French. Elementary French Grammar. Easy French texts. First term (3).

71. Elementary French, continued. Grammar and Composition. Dictation. Reading of short stories by various authors. Second term (3).

72. Elementary French. Sophomore elective for students of the B.A. course who wish three years of French. First and second terms (3).

73. French. Continuation of course 70. Scientific French. Second term (3).

74. French. Thorough review of the Grammar. Composition based on work in the Grammar. Modern French Prose. Dictation. First term (3).

75. French. Continuation of course 74. Composition. Modern French Prose. Second term (3).

76. French. Continuation of course 75. History and Geography of France and her colonies. Commercial correspondence. Composition. First term (3).

77. FRENCH. Continuation of course 76. Second term (3).

78. FRENCH. Rapid reading of French Prose. First and second terms (2).

79. FRENCH. Composition course. First and second terms (2).

80. FRENCH. Rapid Reading. Sight translation. Dictation. Oral drill in the use of a practical vocabulary. First term (3).

81. FRENCH. Continuation of course 80. Second term (3).

82. FRENCH PROSE AND POETRY. Balzac, Flaubert, Maupassant, Daudet, Zola. First term (3).

83. FRENCH PROSE AND POETRY. Continuation of course 82. Molière, Corneille, Racine. Society in the seventeenth century. Second term (3).

84. FRENCH. French literature in the seventeenth century. First term (3).

85. FRENCH. French literature in the eighteenth century. Second term (3).

86. FRENCH. French literature in the sixteenth century and earlier. First and second terms (3).

87. FRENCH. General review of French Literature. Reading, lectures and explanation of texts. First and second terms (3).

88. MODERN FRENCH NOVELISTS. Bourget, Barres, France, Loti, Bazin. Collateral reading and lectures. First and second terms (3).

89. FRENCH. French literature in the nineteenth century. First and second terms (3).

GERMAN

PROFESSOR PALMER, MR. MUELLER, MR. ROEST

90. ELEMENTARY GERMAN. German Grammar and Composition. Easy German texts. First term (3).

91. ELEMENTARY GERMAN, continued. Composition based on work in the Grammar. Dictation. Reading of short stories by various modern authors. Second term (3).

92. GERMAN. More advanced work in the Grammar. Easy composition. Reading of more difficult German prose. First term (2).

93. GERMAN. Continuation of course 92. Composition and dictation. Rapid reading of selections from Scientific German. Second term (2).

94. GERMAN. Thorough review of German grammar. Prose composition. Scientific German. First term (3).

95. GERMAN. Continuation of course 94. Advanced composition. Scientific German. Second term (3).

96. GERMAN. German Prose and Poetry. Heine, Keller, C. F. Meyer, Freytag, Storm, Heyse. Composition. First term (3).

97. GERMAN. Continuation of course 96. Second term (3).

98. GERMAN. Schiller and Goethe. Wallenstein, Faust: Erster Teil. Lectures and composition. First and second terms (3).

100. GERMAN. Nineteenth Century German Drama. Lectures, reading, reports on assigned work. First and second terms (3).

101. GERMAN. Goethe's Dramas: Götz, Egmont, Iphigenie, Tasso, Faust, Zweiter Teil. First and second terms (3).

102. GERMAN. The German Short Story, its origin and development. Rapid reading of illustrative stories, with particular attention to Gottfried Keller, Theodor Storm, C. F. Meyer, and Paul Heyse. Lectures and reports. First and second terms (3).

105. GERMAN. A short course in Advanced German Grammar. For prospective teachers. Elective for Seniors and Juniors who have had German 98. First and second terms (1).

SPANISH

PROFESSOR FOX

110. SPANISH. Spanish Grammar. Reading of easy modern texts. First and second terms (2).

Course 110 is open to Juniors and Seniors. The number of students accepted is limited as the sections are necessarily small.

111. SPANISH. Grammar, reading and composition. Modern Spanish novels and plays. Short outline of Spanish literature. First and second terms (3).

Course 111 is open to all students of the University.

112. COMMERCIAL SPANISH. Preparation required: 111. First and second terms (3).

113. SPANISH. Difficult translation. Prose composition. First and second terms (3).

ITALIAN

PROFESSOR FOX

115. ITALIAN. Grammar and composition. Rapid reading of easy modern prose. First and second terms (3).

116. ITALIAN. Dante's Inferno. Interpretation, lectures and outside reading. First and second terms (3).

ENGLISH

PROFESSOR THAYER, ASSISTANT PROFESSOR LUCH, ASSISTANT PROFESSOR MESCHTER, MR. WALTERS

120. Rhetoric. A composition course based on Genung's Working Principles of Rhetoric and other books, involving recitations and weekly themes on assigned subjects. First term (2).

121. American Literature. Lectures on the basis of Cairns' History of American Literature. Text-book to be read by the student in sections as assigned. The examination is based upon the text-book and the student's notes. First term (1).

122. History of the English Language. Lectures and classroom work, with the use of Emerson's Brief History of the English Language as a text-book, supplemented by Lounsbury's and Champneys'. Second term (2).

123. English Literature. An outline course developed by lectures and recitations, with parallel readings assigned annually. Text-book: Pancoast's English Literature (revised). First term (2).

124. Literary Criticism. The subject varies annually between topics taken from Elizabethan Literature, lyric or dramatic, and from XIXth Century Literature, earlier or later period. Second term (2).

125. Essays, on subjects annually assigned, taken from American authors and requiring the previous reading of some specific work. Six essays a year meet this requirement.

126. Essays, on subjects based on English Literature. Six essays a year meet this requirement.

128. Oratory. A formal course based upon Foster's Argumentation, with recitations and writing of briefs, the composition and delivery of orations, and speeches on topics of current interest. First and second terms (1).

129. Anglo-Saxon. Sweet's Anglo-Saxon Primer and Reader, with lectures on early English Literature, and readings from Brooke and Earle. First term (3).

130. Journalism. A course of practical exercises in writing on scientific subjects and in the principles of journalism. Text-books: Bleyer's Newspaper Writing and Editing, and Earle's Technical Writing. First term (3), repeated in Second term (3).

131. English Philology. The principles of the Philology of the English language as developed in the works of Earle, Trench, Morris and Skeat. By a process of elimination the elements derived from Romance and other sources are excluded, and the

residuum examined, in vocabulary and grammar, as a Teutonic language; with special reference to the intensive development of the tongue previous to the Age of Chaucer. Preparation required: 129. Second term (3).

132. XIX Century Literature; later period 1830-1892. A special study of Tennyson, Arnold and Browning. First term (3).

133. Middle English. A critical study of the English of Chaucer, Langland, Wiclif, and Gower; followed by the literary study of selected specimens of their works. As text-books, The Student's Chaucer (Clarendon Press), Skeat's edition of The Vision of Piers the Plowman, Wiclif's translation of the New Testament revised by Purvey, and Gower's Confessio Amantis are assigned. First term (3).

134. Poetics. A course based on Gummere's Handbook of Poetics, Alden's English Verse, Saintsbury's Loci Critici, and the use of Palgrave's Golden Treasury, and The Oxford Book of English Verse, with practical exercises in verse-composition. Second term (3).

135. Contemporary Drama. Lectures, criticisms and reading of typical plays. Second term (3).

136. The Danish Element in English. A philological study based on Sweet's Icelandic Primer, Groth's Danish Grammar (pp. 1-29, 67-143) and the works of Jespersen and other philologists. Alternative with 133. Preparation required: 129, 133. Second term (3).

137. Optional courses on the Rise and Development of the English Novel and on the Arthurian Cycle are offered in alternate years. These are both lecture courses, with private reading assigned; and, if supplemented by a rigid examination, will be taken as equivalent to one term's work in any class above the grade of Freshman.

MATHEMATICS AND ASTRONOMY

PROFESSOR THORNBURG, PROFESSOR LAMBERT, PROFESSOR OGBURN, ASSISTANT PROFESSOR STOCKER, ASSISTANT PROFESSOR REYNOLDS, MR. ALRICH, MR. KNEBELMAN, MR. STERNER

140. Solid Geometry, beginning with Book VI and completing the subject. Second term (2).

141. Trigonometry. Plane Trigonometry, including the use of

No. 184,, on page 90.

142. Trigonometry. Spherical Trigonometry, including the use of logarithmic tables. Preparation required: 141. First or second term (1).

143. Advanced Algebra, beginning with the Theory of Quadratic Equations. First term (2).

143a. Advanced Algebra. Theory of Equations and other topics. First term (1).

144. Plane Analytic Geometry. Graphic representation of loci on cross-section paper, plane analytic geometry. Preparation required: 140, 142. First term (3).

145. Solid Analytic Geometry; Differential and Integral Calculus. Embracing applications to analytic geometry problems, theory of center of gravity, moment of inertia, together with a short chapter on elementary ordinary differential equations. Preparation required: 144. Second term (5); First term (4).

146. Differential Equations. Preparation required: 145. Second term (1).

147. Analytic Mechanics. Differential equations of motion, treatment of forces in space, free and constrained motion of a particle and of masses, with applications to practical problems. Preparation required: 145. Second term (2).

148. Descriptive Astronomy. A study of the fundamental facts and principles of the subject with solution of problems; observatory visits. Preparation required: 145. Second term (3).

149. Practical Astronomy. Study of instruments used, methods of taking and reducing observations to determine time, latitude, longitude, and azimuth; observatory work in which each student makes his own observations and computations in illustration of the problems studied. As this study is primarily for civil engineers, the sextant and engineer's transit are the chief instruments employed in the observational work. Preparation required: 145, 148, First term (3).

150. Analytic Mechanics. Preparation required: 145, 146, 147. Second term (3).

FREEHAND DRAWING

MR. GELHAAR

155. Freehand Drawing, with special reference to perspective, construction, and machine parts. First term (1).

CIVIL ENGINEERING

PROFESSOR MC KIBBEN, PROFESSOR WILSON,
ASSOCIATE PROFESSOR FOGG, ASSISTANT PROFESSOR BECKER,
MR. HENDRICKS, MR. FULLER, MR. FOX, MR. NOETZLI

160. MECHANICAL DRAWING. The use of drawing instruments. Lettering and tracing. Mechanical drawing from objects. Simple projections. Isometric drawing. First term (2).

161. DESCRIPTIVE GEOMETRY. The descriptive geometry of projections, intersections, and developments. Plans, elevations and sections of simple structural details. Preparation required: 160. Second term (3).

162. STEREOTOMY. Problems in stone cutting, including plans for piers, culverts, and arches. Isometric drawings and linear perspective. Preparation required: 160, 161. First term (3).

163. LAND SURVEYING. The theory and practice of land surveying, including the computation of areas, dividing land, and determining heights and distances. Map drawing and topographic signs. Field work with the level and transit in the determination of heights and distances, and in making surveys of farms. Map drawing from the student's field notes. Preparation required: plane trigonometry, mechanical drawing. Second term (4); also in summer term, four weeks beginning June 7, 1916.

164. LAND SURVEYING. A short course in land and railroad surveying. Similar to course 163 except that parts of land surveying are replaced by the elements of railroad surveying. Preparation required: plane trigonometry and mechanical drawing. Second term (3).

165. RAILROAD SURVEYING. Reconnaissance, preliminary and location methods, with the theory of curves and turnouts. Location of a line, with the preparation of profiles and maps. The computation of earthwork and estimates of cost. Preparation required: 161, 163. Second term (4).

166. TOPOGRAPHIC SURVEYING. The theory and use of the plane table, and of the transit and stadia. Pen topography. Detailed field work in rough country, and the construction of topographic contour maps. Leveling and triangulation. The adjustment of instruments with the investigation of their systematic errors. Preparation required: 163. Summer term, four weeks, beginning June 7, 1916.

167. GEODETIC SURVEYING. Elements of the method of least squares and the application to the adjustment of triangulations.

The figure of the earth. Field work in triangulation, in determination of azimuth, and with the plane table. Preparation required: 144, 147, 148, 165. First term (3).

168. CONSTRUCTION. Lectures covering the history of engineering, including the lives of some of the noted engineers and scientists, the development of building construction, architectural history and a study of the materials of construction. First term (2).

169. CONSTRUCTION. Lectures planned to give the student a general view of the various branches of civil engineering. The lectures cover the subjects of masonry construction in stone and brick, foundations for bridges and buildings, water supply and sewage disposal, development and transmission of water power and the history of bridge construction. Second term (2).

170. RAILROADS. The construction of the roadbed; including ballast, crossties, rails, switches, culverts, and other details. Maintenance of way, and the elements of railroad operation. Visits of inspection, with written reports. Preparation required: 165. First term (2).

171. RAILROADS. Lectures on the economics of railroad location, the arrangement of yards, stations and terminals, train resistance, the application of electricity to the operation of railroads. Preparation required: 170. Second term (2).

172. STRENGTH OF MATERIALS. The elasticity and strength of timber, brick, stone, and metals. Theory of beams, columns, and shafts, with the solution of many practical problems. Preparation required: 320, 321, 322, 145. First term (4).

173. GRAPHIC STATICS. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to the discussion of beams and girders. Preparation required: 320, 321, 322, 200 or 313. First term (2).

174. GRAPHIC STATICS. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to beams and girders. Analysis of stresses in bridge trusses. Retaining walls and masonry arches. Preparation required: 320, 321, 322, 172. First term (2).

175. ROADS AND PAVEMENTS. The location, construction and maintenance of roads and pavements. Preparation required: 168, 169. First term (2).

176. ROOFS AND BRIDGES. The theory and computation of stress in roof and bridge trusses under dead, live and wind loads. Locomotive wheel loads on plate girders and bridge trusses. Preparation required: 172, 174. Second term (3).

177. Hydraulics. Hydrostatics and theoretical hydraulics. The flow of water through orifices, weirs, tubes, pipes, and channels. Naval hydromechanics. Hydraulic motors. Preparation required: 320, 321, 322, 145. Second term (3).

178. Bridge Design. Lectures and drawing exercises. The design of girders and trusses. Computation and drawings are made for a through plate girder railroad bridge and for a highway truss bridge. Preparation required: 172, 176. First term (6).

179. Steel Buildings. Design of roof trusses and three-hinged arches. Mill building construction. Preparation required: 172, 176. First term (2).

180. Bridges and Dams. Higher structures, including continuous, draw, cantilever, and suspension bridges, also metallic arches. The theory and design of masonry walls, dams, and arches. Preparation required: 178. Second term (4).

181. Cement and Concrete. The manufacture, properties, and testing of hydraulic cement, mortar, and concrete. Each student makes all the standard tests in the cement laboratory. Reinforced concrete buildings, arches, and other structures; theory of reinforced concrete. Preparation required: 172, 178. Second term (3).

182. Hydraulic Engineering and Design. Systems of water supply, including purification systems, reservoirs, pipe lines, pumping plants. The design of a water supply distribution system. The measurement of flow in open channels by means of tubes and meters. Water power. Irrigation. Preparation required: 177. First term (4).

183. Sanitary Engineering and Design. Systems of sewerage and methods of sewage treatment and disposal. The design of a sewerage system. House drainage. Preparation required: 182. Second term (3).

184. Engineering Inspection. During the vacation between the Junior and Senior years each student in Civil Engineering is required to inspect some engineering work and prepare a report thereon. A brief description of the work or structure that the student desires to inspect must be presented to the Professor of Civil Engineering before July 15, and after approval the report thereon must be submitted before September 9. These reports will contain such drawings, photographs and computations as each case may demand, and their length will usually be from twenty to thirty pages of letter paper.

185. Elementary Mechanics of Materials. Brief introduction to elements of strength of beams, columns and shafts, especially as applied to elementary machine design. First term (1).

186. Testing Laboratory. Each student makes fourteen experiments in the Fritz Engineering Laboratory, which is equipped with 20,000, 50,000, 100,000, 300,000, and 800,000-pound machines for tension, compression, and flexure, a 50,000-inch-pound machine for torsion and other apparatus for special work. Preparation required: 172. First term (1).

187. Hydraulic Laboratory. Each student makes fourteen experiments in the hydraulic section of the Fritz Engineering Laboratory, which is equipped with pumps, weirs, turbines, waterwheels, meters and other apparatus for special work. Preparation required: 177. Second term (1).

188. Thesis for Degree of C.E. Candidates for the degree of Civil Engineer select the subjects of their theses in the first term of the Senior year. Advice is given in regard to the plan of work, and references to literature are indicated. Reports concerning the progress of the investigation are made at intervals during the second term. The thesis is regarded as a part of the final examinations of the course.

For information in regard to the Fritz Engineering Laboratory, see page 135.

Summer Schools in Civil Engineering

Surveying. Exercises in Land Surveying and Topographic Surveying, designed primarily for students of the University, but open to all persons prepared to take them, are given in the Summer vacation. In 1916, this work begins at 8 a.m., on June 7, and ends on July 5.

The work of Land Surveying is described under No. 163, on page 88. Students in Mining Engineering are required to take this work at the close of the Sophomore year in connection with some Topographic Surveying. The fee for other persons is $20.

The work in Topographic Surveying is described under No. 166, on page 88. Students in Civil Engineering are required to take this subject at the end of the Sophomore year. The fee for other persons is $20.

Inspection Report. Inspection of engineering work and a report thereon is required of all students in civil engineering during the vacation following the Junior year. This is described under No. 184, on page *90*.

MECHANICAL ENGINEERING

PROFESSOR J. F. KLEIN, PROFESSOR DE SCHWEINITZ,
PROFESSOR A. W. KLEIN, ASSISTANT PROFESSOR BUTTERFIELD,
ASSISTANT PROFESSOR LARKIN, MR. SPENCER, MR. RHOADS

200. DRAWING AND ELEMENTS OF MACHINE DESIGN. Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of machine drawing by isometric sketches. General view from given details. Sections of stub ends and valve passages. Intersection of boiler flues. Empirical proportioning of machine parts. First term (3).

201. CONSTRUCTIVE ELEMENTS OF MACHINERY. Visits of inspection. Examination and sketching of machine parts and machinery. A classified and numbered list of some three hundred and sixty items is given to each student, who makes a written report on them with freehand sketches containing the leading dimensions. The class is divided into sections, which are separately taken into shops by the instructor, who then indicates the pieces that are to be examined and gives all necessary explanations. In addition a score of machines of all sorts are taken apart and again put together by this class. This work is accompanied by Constructive Elements of Electrical Apparatus, No. 350. Summer term, four weeks, beginning June 7, 1916.

202. ELEMENTS OF MACHINE DESIGN. Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers, and connecting rods. Second term (3).

203. BOILERS. Description of various types, and details of construction, staying, setting, etc.; strength of the structure; accessories; fuels and furnaces; operation; wear and tear; visits of inspection to a boiler shop and to a boiler plant. Text-book: Parson's Steam Boilers. First term (1).

204. STEAM ENGINES. Elementary Thermodynamics, theory of the ideal heat engine, properties of steam and efficiency of the steam engine. Mechanics of the engine, steam pressures, inertia resistances, turning force diagrams, etc. Valve gears, valve diagrams applied to slide valves, shaft governors, and link motion. The steam engine indicator and study of diagrams. Outline of the study of economy, compounding, etc. The descriptive work is supplemented by shop visits. The solution of many graphical and numerical problems is required. Text-book: Heck's Steam Engine. Second term (4).

205. Steam Engine. Shorter course. Second term (3).

206. Mechanical Technology. Each student is required to give a full written description of the various processes, operations, and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings and finished pieces, which are under construction in the shops at the time and drawings for which have been given to him on entering the shops. The student's work is personally directed by an instructor, who accompanies him in each shop, gives necessary explanations, and tests the extent and accuracy of his knowledge. Four teachers are engaged in this work, one for each shop and section. Summer term, four weeks, beginning June 7, 1916.

207. Mechanics of Machinery. Graphic statics of mechanisms. Determination of the efficiency of a machine and of the forces acting in every one of its pieces and parts. All the problems are given to the students in the form of black prints and consist of a series of suitably graded examples of machinery. In these both frictional and inertia resistances are considered. First term (2).

208. Engineering Laboratory. Use and calibration of apparatus for measuring weight, volume, pressure, temperature, speed, etc., for engineering purposes. First term (2).

209. Engineering Laboratory. Work of 208 continued. Indicator practice, on engines in the laboratory and in factories and power plants in the neighborhood; complete working up of indicator diagrams from simple and compound engines, air compressors, etc. Second term (1).

211. Mechanics of Machinery. Machinery of Transmission. Weisbach-Herrmann series: Vol. III, Part I, Section I. This treats of the Mechanics of Machine Parts and determines their dimensions from considerations of strength and durability. The Introduction is also studied for its excellent analytical presentation of the subject of acceleration. Second term (3).

212. Summer School in Engineering Laboratory. Simple tests with steam; steam calorimeters, injectors, flow of steam, performance of steam-traps, etc.; tests of small steam pumps, of a steam turbine, of engine performance; of hot-air and gas engines, and of an air compressor. Boiler management and testing. Dynamometer work, belt testing, friction and lubrication. Summer term, four weeks, beginning June 7, 1916.

216. Thermodynamics. Proof of the fundamental laws; equations of condition for air and superheated steam; the relations between pressure, volume, temperature, work and heat for special

changes of state. Establishment of the fundamental equations of thermodynamics and their adaptation to gases and technical problems. Text-book: Zeuner's Technical Thermodynamics. First term (5).

217. KINEMATICS OF MACHINERY. This treats of the constrained motion peculiar to machinery and of the nature and equivalence of mechanisms. As here pursued it consists of a few lectures accompanied by a large amount of work in the drafting room. The work is expended on the construction of centrodes, on inversions and skeletons of mechanisms and also on the preparation of displacement, velocity and acceleration diagrams for a great variety of machines. This is followed by much practice in mass and force reductions, the latter including all forms of inertia resistance and external forces. First term (4).

218. ADVANCED MACHINE DESIGN. This covers the design of machines in general, such as machine tools, hydraulic machinery, including pumps, etc., hoists, cranes, etc. Each student is required to design several machines individually, to gain experience in designing and in proportioning the various parts for strength, stiffness and other requirements. First term (4).

220. ENGINEERING LABORATORY. Work of 209 and 212 continued. Tests of boilers, of power plants and of pumping stations in the neighborhood. Advanced work along the lines of 212. First term (1).

221. ENGINEERING LABORATORY. A shorter course, selected and condensed from 208 to 228 especially in steam engineering, for students in Metallurgical, Mining, and Electrical Engineering, and Electrometallurgy. First term (1).

222. ENGINEERING LABORATORY. Work of 221 completed, along same lines. Second term (1).

224. ADVANCED MACHINE DESIGN. This is a continuation of course 218, being more specialized. Second term (4).

227. MECHANICS OF MACHINERY. Hoists, Pumps, Compressors, Blowing Engines, and Fans. The presentation is that of the Weisbach-Herrmann series. The class-room work is supplemented by suitably timed visits of inspection. Second term (4).

228. ENGINEERING LABORATORY. Work of 220 carried forward, along same lines. Analysis of flue gases; complete tests of the power plants of the vicinity. Second term (1).

229. STEAM TURBINES. The Mechanics, Thermodynamics, Construction and Experimental Results of the Steam Turbine. Text-book: Stodola. Second term (5).

230. Gas Engines. The Mechanics, Thermodynamics, Thermochemistry, Construction, and Tests of the Gas Engine. Text-book and reference-book: Carpenter & Diederichs. First term (3) or (2).

231. Thesis for Degree of M.E. Candidates for the degree of Mechanical Engineer are required to present theses upon topics connected with mechanical engineering. Drawings and diagrams are required whenever the subjects discussed need such illustration.

For Summer Schools see courses 201 (connected with course 350), 206, and 212, also statement on page 117.

METALLURGY

PROFESSOR RICHARDS,
ASSISTANT PROFESSOR ROUSH, MR. CALLEN

243. Metallurgical Design. Execution of designs accompanied by working drawings and estimates of material and cost for the erection of metallurgical plant under given conditions. Second term (2).

244. Electrometallurgical Design. Execution of designs accompanied by working drawings and estimates of material and cost for the erection of an electrometallurgical plant under given conditions. Second term (2).

245. General Metallurgy. Metallurgical processes. Principles of combustion. Principles of thermo-chemistry. Measurements of high temperatures. Fuels, natural and artificial, solid and gaseous. Fluxing. Refractory materials. Classification of furnaces. Artificial draft and blast. Electric furnaces. Reference books: Hofman's General Metallurgy, Second Edition; Fulton's Principles of Metallurgy. Second term (2).

246. Metallurgy of Iron. Chemical and physical properties of iron. Iron ores. Preparation of ores. The blast furnace. The mixer. Remelting. Pig washing. Puddling. The Bessemer process. The open hearth process. Duplex processes. Cementation. Manufacture of crucible steel. Electric steel. Direct processes. Methods of casting and forging. Reference books: Ledebur's Eisenhüttenkunde, Stoughton's Metallurgy of Iron and Steel. Second term (2).

247. Metallurgical Problems. A course of fifteen problems embodying the use of the physical, chemical and mechanical principles utilized in practical metallurgy. Reference: Richards' Metallurgical Calculations, Parts I and II. Second term (1).

248. General Metallurgy. Shorter course. Reference books: Fulton's Principles of Metallurgy, Richards' Metallurgical Calculations. For Civil Engineering students, First term (1). For Mechanical Engineering students, Second term (1).

249. Metallurgy of Iron, Steel and Other Metals. Shorter course. Reference books: Stoughton's Metallurgy of Iron and Steel. Harbord's Metallurgy of Steel. First term (1). Second term (1).

250. Metallurgical Problems. A course of problems embodying the use of physical, chemical and mechanical principles utilized in practical metallurgy, particular attention being paid to the needs of the Civil and Mechanical Engineer. As above, First term (1). Second term (1).

Courses 248, 249 and 250 are an abridgment of courses 245, 246, 247, and 251, for students of Civil, Mechanical and Electrical Engineering.

251. Metallurgy of Copper, Lead, Silver, Gold, Zinc, Tin, Mercury, Nickel, Aluminium, etc. Copper: Chemical and physical properties. Ores. Smelting sulphide ores. The Bessemer process. Treatment of oxide ores. Wet processes. Electrolytic processes. Lead: Chemical and physical properties. Ores. Smelting processes. Condensation of lead fume. Refining and desilverization of base bullion. Silver: Chemical and physical properties. Ores. Smelting with lead. Amalgamation. Leaching processes. Gold: Chemical and physical properties. Ores. Gold washing. Gold milling. Chlorination. The cyanide process. Parting gold and silver. Zinc: Chemical and physical properties. Ores. Belgian and Silesian processes for the manufacture of spelter. Manufacture of zinc oxide. Electrolytic processes. Mercury: Chemical and physical properties. Ores. Processes of extraction. Aluminium: Chemical and physical properties. Ores. Extraction by electrolysis. Tin, Nickel, Platinum, Antimony, etc.: Chemical and physical properties; Ores; Alloys; Processes of Extraction. Reference books: Schnabel's Handbook of Metallurgy, Gowland's Metallurgy of the Non-Ferrous Metals, Hoffman's Metallurgy of Copper. First term (4).

252. Metallurgical Problems. A course of fifteen problems concerned with the principles utilized in the metallurgy of the non-ferrous metals. Reference: Richards' Metallurgical Calculations, Part III. First term (1).

253. Metallurgical Laboratory. Calibration and use of instruments employed in metallurgical investigations, pyrometers and

calorimeters, etc. Determination of efficiencies of furnaces. Roasting and matting experiments. Investigation of leaching processes. Fee, $5; deposit, $5. Second term (1).

254. Electrochemistry. Lectures discussing the phenomena of electrolysis and the various theories proposed to account for them. Special consideration of secondary reactions, and also of the quantitative relations between electrical and chemical energy, and their mutual convertibility. Reference book: Le Blanc's Textbook of Electrochemistry, Allmand's Applied Electrochemistry. First term (1).

255. Electrometallurgy. Lectures discussing the practical applications of electricity to metallurgical processes. Electrolytic and electric furnace plants and practice. Reference books: Borcher's Electric Smelting and Refining. Neuburger's Handbuch der Praktischen Elektrometallurgie. Second term (1).

256. Electrochemical Laboratory. Quantitative separations and depositions of metals by electrolysis. Experimental determination of the conditions controlling the nature of electrolytic deposits. Electrolysis of salts. Cathodic Reduction. Fee, $5; deposit, $5. First term (1). For students in the course of Electrometallurgy: fee, $10; deposit, $10. First term (2).

257. Electrometallurgical Laboratory. A continuation of 256, attention being directed more to electrometallurgical processes, as of refining, reduction, etc. Electric Furnace work. Fee, $5; deposit, $5. Second term (1).

258. Metallography. The study of Metals and Alloys: their physical, chemical and microscopic properties together with deductions drawn therefrom. The influence of thermal and mechanical treatment on physical properties and structure. Lectures and laboratory work. Fee, $10; deposit, $10. Reference books: Gulliver's Metallic Alloys, Sauveur's Metallography and Heat Treatment of Iron and Steel. First term (2).

260. Blowpipe Analysis. Laboratory work in quantitative blowpipe analysis, dealing particularly with the determination of gold, silver, cobalt, nickel, copper, lead, tin, bismuth, mercury, and analysis of coal. Reference book: Plattner's Blowpipe Analysis, latest English edition. Fee, $4. Second term (1).

(Extra courses in the reading of Technical German and French are offered during the second term by the staff of this Department.)

261. Thesis for Degree of Met.E. Every student in Metallur-

gical Engineering is required to present a thesis on some topic connected with this subject.

262. Thesis for Degree of El.Met. The thesis required for this degree will be upon some subject connected with the theory or practice of Electrometallurgy.

For Summer Schools see courses 201, 350, and 206, also statement on page 117.

GEOLOGY

PROFESSOR MILLER, ASSISTANT PROFESSOR HINTZE, MR. MATTESON, MR. IRWIN

266. Mineralogy. Short course. The principles of crystallography with practice in the determination of forms on models and crystals. The physical properties, origin, occurrence, association, and alteration of minerals. Methods of study and classification. A study of about one hundred and fifty of the common mineral species and varieties, particularly the rock-forming minerals, with practice in identification based on association and physical properties. First term (4).

267. Mineralogy. Long course. Similar to 266, but covering two hundred mineral species. First term (5).

(A deposit of $5 is required from each student taking course 266 or 267, to cover damage to collections and instruments and the value of supplies furnished him. In case the damage consists only of ordinary wear and tear the amount retained to cover it is about $3 for each student.)

268. Blowpipe Analysis. An elementary course in blowpipe analysis considered as a method of qualitative chemical analysis. Illustrated lectures followed by practical testing of thirty-five bases and fifteen acid radicles. Fee, $2. First term (1).

269. Blowpipe Analysis. Advanced blowpipe tests and separations. The application of blowpipe methods as primary tests in determinative mineralogy. (A deposit of $2 is required to cover cost of gas, chemicals, and specimens supplied.) Preparation required: 268 and 266 or 267. Second term (1).

270. General Geology. A course in dynamic, structural and historical geology. The text-book is supplemented by illustrated lectures in which the relation of geology to engineering problems is discussed. The different geologic periods and their characteristic types of life are studied. The principles of organic evolution as shown in the development of new forms in the successive periods are treated; also a brief review of the geology of the

North American continent and the physical changes which it has undergone during its development. Second term (2).

271. Petrology, Geological Laboratory and Field Trips. This course is designed primarily to enable students to determine and to classify the various types of rocks without the use of the microscope. The principles of rock classification are discussed in a series of lectures which are supplemented by laboratory practice with a petrologic collection comprising rocks gathered from all parts of the world. Attention is also given to the examination of the varieties of rocks used for constructional purposes with discussions of the factors which render them desirable. In addition, a series of lectures is given on primary and secondary rock structures, supplemented by laboratory work on the interpretation and construction of topographic and geologic maps and sections. During the spring months, field trips are taken weekly to nearby localities to study rock structures and deposits of economic importance. The region furnishes excellent examples of varied structures and contains numerous quarries where slate, cement rock, limestone, sandstone, gneiss, and serpentine are obtained, all of which are visited by the classes. On such field trips, special attention is given to the methods of geologic mapping. Preparation required: 266 or 267. Second term (3), (2) or (1).

(A fee of $1 is required of each student taking course 271 to cover damage to collections and the value of supplies furnished.)

272. Economic Geology. The non-metallic minerals and substances, their origin, modes of occurrence, properties, sources, production and uses are studied. Comprehensive reports on various products comprise a portion of the work. Preparation required: 266 or 267, 270 or 271. Second term (2).

274. Economic Geology. Metallic Minerals. Causes of the formation of cavities in rocks, their relation to metalliferous deposits; discussion of the theories of ore-deposition; the structure, geological horizon, and geographic distribution of the principal metallic economic deposits of the United States. Recitations, illustrated lectures, field trips, and laboratory work. For the purpose of studying ore occurrence, visits are made to the zinc mines of Franklin Furnace and Friedensville, the magnetite mines of Dover, New Jersey, and Cornwall, Pennsylvania, the limonite mines of Ironton, and the anthracite coal mines. Each student is required to prepare a series of maps illustrating the location, production, chemistry, and geology of the economic products of

the United States. Preparation required: 270 or 271. Second term (3).

275. Paleontology. A study of the principles of stratigraphy; fossils, their classification and origin; laboratory practice in the determination of the geologic age of formations by the contained fossils. Visits to several localities for collecting fossils are held in conjunction with this work. The origin, modes of deposition, physical characters, structure, occurrence, and distribution of stratified rocks. Evidences of evolution among fossils with a study of the underlying principles and causes. Preparation required: 270 or 271. First term (2).

276. Geology of North America. The geological age and geographical distribution of the rocks of which North America is composed; the structure and history of its mountain ranges; the history of its geological development and origin; reviews of the great surveys that have been made. Lectures and laboratory work. Preparation required: 270 or 271. Second term (3).

277. Physiography. The cosmic relations of the earth; the classification of land forms; the study of their origin, growth, and decay and the factors governing their development; their geographical distribution. Topographic maps; the relation of topography to geologic structure. The response of man and other organic life to an inorganic environment with special reference to the influence of Physiography upon the economic development of countries. Second term (3) or (2).

278. Field Geology. Geological maps—their use and the methods by which they are constructed. Practice in the actual working out of surface geology. Problems in plotting geology on topographic maps; each student will be assigned a definite area and will be required to make a geological map of it with structure sections. He will also collect a full set of specimens to illustrate the geology. The first part of the course will be devoted exclusively to field work and the notes then taken will be worked up in the laboratory when the weather prevents further out-door work. A fee of $1 is charged to students taking this course. Preparation required: 270 or 271. First term (2).

279. Petrography. The optical properties of minerals and their study with the petrographic microscope. Petrography of the more important igneous rocks. Lectures, recitations, and laboratory work. A laboratory fee of $3 is charged all students taking this course. Preparation required: 266 or 267, 323. First term (2).

280. Petrography. Further study of igneous, sedimentary, and metamorphic rocks. Preparation of thin sections from selected rock chips in the laboratory, followed by detailed studies with the microscope to determine mineral composition, structural features, alterations, etc. A report based on these studies is required. A laboratory fee of $3 is charged all students taking this course. Preparation required: 279. Second term (1).

281. Physiography. A study of topographic forms and the processes that have produced them; the weather and climate; and the influence of physical conditions upon the development of countries. Salisbury's Physiography is used as a text-book. First term (3).

282. Physiography. A continuation of Course 281. Recitations, lectures, laboratory work, and field trips. In this work a study is made of the physiographic regions of North America and Europe. The student becomes familiar with topographic maps and the preparation of weather and climate charts. Emphasis is placed on the effect that physiographic conditions have in determining the commercial and industrial importance of nations. Second term (3).

283. Mining and Geologic Law. A study of the legal matters that confront a mining geologist. The law in regard to underground waters and mineral products is studied and abstracts of important cases, accompanied by drawings showing the geologic conditions upon which the decisions were made, are prepared. Shamel's Mining and Geologic Law is used as a reference work. First term (1).

284. Structural Geology. The study of special features of structural Geology in the field and laboratory. First term (1).

285. Geologic Methods. The study of methods employed by the geologist in the various lines of geologic investigation. In this study the student is made familiar with the methods employed by the United States Geological Survey and by the mining companies that employ geologists. Special attention is given to the problems that confront an economic geologist in the investigation of coal lands, oil properties, metal mines, etc. Second term (3).

BIOLOGY

PROFESSOR HALL, MR. THOMAS

290. Botany. An elementary course treating of the structure and classification of plants. Lectures, laboratory work, and refer-

ence to text-books. Preparation advantageous: 292. Second term (2).

291. Forestry. Lectures, recitations and laboratory work. The lectures cover a brief introduction to botany. This is followed by lectures on dendrology and text-book work on Forestry. The laboratory work is devoted mainly to dendrology and the characteristics of the wood of important timber species. Field trips during the Autumn enable the student to become familiar with the trees of the region. First term (3).

Careful consideration has been given by friends of the University and by the Board of Trustees to the matter of Forestry as one of the very live issues of the day in connection with the general attention that is now being directed to the conservation of our natural resources. It does not appear to the Trustees that at the present time the call for professional foresters is such as to justify the establishment of a School for Forestry at the University, but it seems that the question is of such great and growing importance that the University should do its part toward calling the attention not only of its students but of the public in the section of country more directly reached by the influence of the University, to the growing need of a better knowledge of the principles involved. To this end, courses of lectures have been instituted to which the public has been invited and special instruction is being given in Forestry in certain of the courses.

In furtherance and support of the cause of Forestry the University has offered free tuition scholarships to graduates of the Pennsylvania State School of Forestry at Mont Alto, to pursue, as special students at this University, courses supplementary and cognate to their studies at Mont Alto.

292. Biology. Lectures, recitations, and laboratory work. The lectures discuss the following topics: (*a*) fundamental conceptions; life, protoplasm, the cell, etc.; (*b*) the structure, development, relationships, habits, and geographic distribution of animals; (*c*) the more important biological theories; variation, heredity, evolution, etc. In the laboratory, types of the various phyla are dissected and drawings made. First term (3).

293. Comparative Anatomy of Vertebrates. Lectures on the comparative anatomy of vertebrates, with a more extended discussion of biological theories. The laboratory work consists of the dissection of types of the several vertebrate classes. Preparation required: 292. Second term (3).

294. Vertebrate Embryology. Lectures, reading and laboratory work. By the study of living, preserved, and sectioned material, the successive stages of cleavage, gastrulation, and the formation of organs are demonstrated. Preparation required: 293. First term (2).

295. Sanitary Biology. Lectures, recitations, assigned reading and laboratory work. Study of bacteria; microscopical appearance, methods of staining, plate and tube culture, etc. The quantitative and qualitative bacteriological and microscopical examination of water. Second term (2).

296. Bacteriology. Recitations and laboratory work. After the general study of bacteria, special attention is paid, in this course, to those forms which are economically important, such as those of water, foods, dairy products, soils, etc. Preparation advantageous: 290 or 292. First term (2).

297. Advanced Bacteriology. Lectures and recitations on the study of disease, immunity and sanitation. Laboratory work on the determination of species, with a special study of the pathogenic bacteria. Opportunity is given for the independent study of special problems in practical hygiene. Preparation required: 295 or 296. Second term (2).

(A fee of $3 is required in courses 292, 295, 296, and 297, to cover cost of material and breakage.)

DR. ESTES

298. Hygiene. Lectures intended to teach the students some idea of the importance and the methods of personal hygiene and sanitary laws will be given during the course. It is also intended to suggest to young men who may become engineers, miners, and explorers the importance of and how to take proper measures for the sanitary comfort and personal well-being of men who may, in after life, be under their control and leadership.

MINING ENGINEERING

PROFESSOR ECKFELDT, MR. SMITH, MR. BARTLETT

299. Prospecting. Surface indications of minerals, including oil, gas and water. Geologic interpretations of strata and outcrops. Prospecting on surface and underground; also by boring. Magnetic prospecting. Mapping of prospects. Sampling, estimation and valuation of mineral deposits. Locating and patenting mining ground. (This course is designed for those who do not take 300.) Preparation required, 270, 271. First term (2).

300. Prospecting. Modes of occurrence of minerals. Uses of Geology. Prospecting for placer, vein and bedded deposits. Magnetic prospecting. Preliminary boring. Sampling. Valuation of property. Location of claims. Patents to mining ground. Preparation required: 270, 271. First term (1).

301. Boring. Uses of bore holes. Methods: by rotation; by percussion with rods and ropes. Special methods: shaft sinking by boring. Survey of bore holes. Preparation required: 270, 271. First term (1).

302. Mining. Location of plant; breaking ground; tools and machines. Explosives; laws; blasting. Shaft and slope sinking. Tunneling. Supporting excavations; timber, metal, masonry. Development of deposits. Systems of mining underground and at surface. Preparation required: 270, 271. First term (1). Second term (1).

303. Transportation. Hoisting: Motors, ropes, and attachments. Receptacles. Safety appliances. Laws. Systems of hoisting. Haulage: Surface and underground. Motors, vehicles. Systems: wire rope; aerial tramways. Loading and unloading; stocking and storage of minerals. Transportation of workmen. Signaling. Preparation required: 320. Second term (1).

304. Drainage. Surface water. Prevention of access. Dams. Drainage by tunnels. Mechanical drainage; hoisting water; pumping. Classes of pumps. Classes and positions of motors. Preparation required: 320. Second term (1).

305. Ventilation and Lighting. Atmosphere of mines. Pollution. Natural and artificial ventilation. Systems. Classes and efficiencies of ventilators. Testing air. Instruments. Laws. Lighting: Methods. Dangers. Laws. Safety-lamps. Lighting by electricity. Preparation required: 320-323. Second term (1).

306. Accidents. Classes. Causes. Means of prevention. Rescue. Hygiene of mines; rules and laws. First aid to injured. Second term (1).

307. Mine and Railroad Construction. The use of stone, brick, cement, concrete, metal and timber with special reference to mining plant. Foundations, piling, dams, reservoirs, retaining walls, mine buildings, railroads, trestles, tipples, ore-bins and docks. Preparation required: all of preceding mining subjects. First term (2).

308. Mine Administration. Management, organization, employment of labor, mine accounts, etc. Preparation required: all of preceding mining subjects. Second term (1).

309. Ore Dressing. Theory of ore dressing. Physical principles involved. Machines used in wet, dry, magnetic, and flotation methods: order of arrangement. Processes. Location of works. Preparation of anthracite and bituminous coal. In connection with this course, required trips are made to mills and to anthracite breakers. Preparation required: 266 or 267. First term (2).

310. Ore Dressing Laboratory. Experimental studies and tests of machines and processes used in the preparation of ores and coal. Deposit, $10. Preparation required: 266 or 267, 201, 412, and 350. First term (1).

311. Mine Surveying; Railroad Surveying. Instruments. Forms of notes. Outside work. Determination of meridian. Inside work. Connecting outside and inside work through shafts, slopes, or tunnels. Calculation of notes; mapping. Railroad Surveying: preliminary and location methods; theory of curves, turnouts, etc. Care of maps. Detection of errors. Special problems. Fee, $1. Preparation required: 163 or 164. Summer term at the end of Junior year, four weeks, beginning June 7, 1916.

312. Mechanical Drawing. The use of instruments. Tracing and lettering. Descriptive Geometry; isometric and orthographic projections; intersections and developments of cylinders, cones, spheres, etc. Sketches and working drawings of machine parts. Blue printing. Fee, $1. First term (2). Second term (2).

313. Drawing and Design. Continuation of 312. Designing of machine parts, such as bolts and nuts, screws, bearings, shafts, pulleys, gearing, etc. First term (2). Second term (4).

314. Metallurgical Construction. Examination and sketching of parts of metallurgical plants in the vicinity. General views and drawings of metallurgical plants, accompanied by recitations and reports on construction and operation. Preparation required: 312, 313. First term (3).

315. Mining Design. The design of parts of mining plant to meet given conditions, with detailed working drawings, accompanied by estimates of material and costs. Preparation required: 312, 313, 172, and mining subjects. Second term (3).

316. Thesis for Degree of E.M. Candidates are required to present a thesis on some topic connected with mining engineering. With the approval of the professors concerned a subject may be taken from some topic in the geological, metallurgical, or other department.

For Summer Schools, see courses 201, 350, 163, 166, and 311, also statement on page 117.

For description of the Eckley B. Coxe Mining Laboratory, see page 135.

PHYSICS

PROFESSOR MAC NUTT,
ASSISTANT PROFESSOR WILY, ASSISTANT PROFESSOR CHARLES,
MR. FRY, MR. FRAIM, MR. BUCHNER, MR. JAUNCEY

320. Elementary Mechanics. Statics. Lecture demonstrations and recitations. First term (2).

321. Elementary Mechanics. Dynamics. Heat. Lecture demonstrations and recitations. Second term (4).

321a. Mechanics Laboratory. Precise Measurements. Second term (1).

322. Elementary Physics. Electricity and Magnetism. Lecture demonstrations and recitations. First term (3).

322a. Physical Laboratory. Mechanics, Heat and Electricity. First term (1).

323. Elementary Physics. Light and Sound. Lecture demonstrations and recitations. Second term (3).

323a. Physical Laboratory. Electricity, Magnetism, Light and Sound. Second term (1).

324. Elementary Physics. A brief general course. Lecture demonstrations, recitations and laboratory. First term (3). Second term (3).

325. Advanced Theory of Electricity and Magnetism. Lectures and recitations. Ferro-magnetism, Electro-magnetism, Induced Electromotive Force and Inductance, Magnetic Properties of Iron, Electric Charge and the Condenser, Electric Field, Potential, Electric Oscillations and Waves, Electron Theory, Electrolysis. First term (2).

326. Electrical Laboratory. Precise measurements. First term (1).

327. Electrical Laboratory. Precise measurements. (Continuation of 326.) Second term (1).

328. Electrical Laboratory. Experimental studies and tests chiefly in electrolysis and photometry. First term (1).

329. Theoretical Physics. Elective courses are offered in the Theory of Heat, in the Theory of Electricity and Magnetism, and in the Theory of Optics. Arrangements as to topic and as to time

to be devoted to it are made for each group of students who elect Theoretical Physics. First or second term (3) to (5).

330. Physical Research. Special advanced students may elect to pursue experimental investigations in Physics. Arrangements as to topic and as to time to be devoted to it are made for each individual student. First or second term (2) to (4).

A fee of $6 is required in connection with courses 321a, 322a, 323a, 326, 327, 328, and 330.

ELECTRICAL ENGINEERING

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT, ASSISTANT PROFESSOR SCHEALER, MR. GRUBER, MR. CONNER

350. Constructive Elements of Electrical Apparatus. Studies of electrical machinery and appliances with the object of familiarizing the student with principles of operation, structural details, and practical uses. The student is supplied with a complete printed outline of the work to be done containing full instructions and explanations. The work consists of three parts, as follows: (*a*) Illustrated lectures, (*b*) Inspection and sketching of electrical machines and apparatus, and (*c*) Visits of inspection to neighboring electric light and power plants. Written reports are required on each day's work. Fee, $3. This work is accompanied by Constructive Elements of Machinery, No. 201. Summer term, four weeks, beginning June 7, 1916.

351. Electric Wiring. Systems of direct current distribution; wiring formulas and applications; installation of electrical machinery and apparatus; interior wiring, overhead and underground construction; rules and regulations of the National Board of Fire Underwriters. Preparation required: 350. First term (1).

352. Dynamos and Motors. Review of elementary electricity and magnetism with special reference to their application to the dynamo. The construction, operation and control of direct current machinery; practical operation and management of dynamo machines; station equipment; cost of electrical energy; electromagnets, magnetism of iron; characteristic curves, armature windings. Illustrative problems. Preparation required: 322, 351. Second term (3).

353. Dynamo Laboratory. Introductory course supplementing the class work of 352. Experimental studies and tests of direct current generators, motors, and appliances, for characteristics, regulation, efficiency, insulation, etc. Fee, $6. Preparation required: 322, 351. Second term (1).

354. Dynamos and Motors. This is an abbreviated course adapted to those students who do not continue this subject in the following year. Special attention is given to the operation, regulation, management and methods of testing of dynamos and motors. Illustrative problems. Preparation required: 322. First term (2).

355. Dynamo Laboratory. Introductory course supplementing the class work of 354 or 372. Experimental studies and tests of direct current generators and motors for characteristics, regulation, efficiency, etc. Fee, $6. Preparation required: 322. First or Second term (1).

356. Dynamo Laboratory. Continuation of 355 and supplementing the class work of 362 or 379. Advanced testing of direct current machines; practice is given in operating and testing alternating current apparatus. Fee, $6. Preparation required: 355, and 354 or 372. First or Second term (1).

357. Theory of Alternating Currents. A general survey of the elementary theory of alternating currents. Lectures, recitations and problem work. Preparation required: 352 or 354. First term (2). Second term (2).

358. Dynamo-Electric Machinery. Continuation of 352. Advanced study of dynamo and motor characteristics, theory of regulation, armature windings, armature reactions; illustrative problems. Preparation required: 352. First term (2).

359. Dynamo Laboratory. Continuation of 353. Advanced testing of direct current machines. Fee, $6. Preparation required: 352, 353. First term (1).

360. Theory of Alternating Currents. Continuation of 357. Advanced theoretical studies of alternators, synchronous motors, and synchronous converters. Preparation required: 357, 358. Second term (2).

361. Electrical Engineering. Continuation of 358. General survey of the more important industrial applications of electricity. Systems of transformation, distribution, and transmission by direct and alternating currents; feeder regulation; arc and incandescent lighting. Preparation required: 357, 358. Second term (1).

362. Electrical Engineering. Continuation of 354. Similar in general scope to 361 but particularly adapted to students who do not further specialize along the technical lines therein outlined. Special attention is given to outside and interior wiring; overhead and underground line construction. The latter part of this

study is devoted to the standard types of alternating current machines, including alternators, motors, rotary converters and transformers, being supplementary to 357. Preparation required: 354, 355. Second term (2).

363. Dynamo Laboratory. Continuation of 359. Advanced testing of direct current machines. Fee, $6. Preparation required: 357, 359. Second term (1).

365. Alternating Current Machinery. Study of the structural details, characteristics and operation of alternators, alternating current motors, rotary converters, and transformers; application of vectors. Preparation required: 325, 360, 361. First term (4).

366. Dynamo Testing. Lectures on the methods of testing electrical machinery and apparatus, including direct current generators, motors, and motor-generator sets. Special methods of testing large machines; commercial tests as carried out by the large manufacturing companies. Preparation required: 325, 257, 358, 359. Second term (1).

367. Dynamo Testing. Continuation of 366. Lectures on testing of alternating current machinery and apparatus,, including generators, motors, rotary converters, transformers, induction regulators, etc. Preparation required: 360, 366. First term (1).

368. Dynamo Laboratory. Experimental studies and tests of alternating current generators and motors, synchronous converters, transformers, and auxiliary apparatus; measurement of power in polyphase circuits. Fee, $12. Preparation required: 360, 361, 363. First term (2).

369. Electrical Design. Calculations of electromagnetic mechanisms and direct current dynamo-electric machinery; a graded series of problems leading up to original designing; drafting. Preparation required: 325, 360, 361, 363. First term (2).

370. Electric Stations. Consideration of prime movers; generating machinery, discussion of types and operation; auxiliary machinery and transformers; storage batteries and their application; switch-boards, measuring and protective devices; design and arrangement; station characteristics; sub-stations; operation and management; visits to neighboring plants. Preparation required: 355 or 356, 361 or 362. First term (2).

371. Electrical Engineering Seminary. A weekly meeting is held in the department reading room for discussion of topics from the current journals of theoretical and applied electricity. Presentation of papers on assigned topics; new inventions and discoveries

critically reviewed. Preparation required: 357, 361. First term (1).

372. Electrotechnology. Review of the principles of electricity and magnetism, with special reference to their application to dynamo electric machinery; the elementary theory of direct current generators and motors; ratings and guarantees; practical operation of dynamos; station equipment; cost of power, systems of metering; electric distribution and wiring; electric lighting. Illustrative problems. Preparation required: 322. First term (2).

373. Electrical Design. Continuation of 369. Calculations of alternating current apparatus, including generators, motors, transformers, and rotary converters leading up to original designing; drafting. Preparation required: 365, 369. Second term (3).

374. Electric Traction. The construction, equipment and operation of different types of electric railways. The application of electric traction under steam railroad conditions; the dynamics of electric train movement; predeterminations of speed-time curves and the power required for different types of runs. Choice of car equipment; cost of construction and of operation. Testing of railway systems. Visits of inspection to power plants are made and reports required. Preparation required: 365, 370. Second term (3).

375. Electric Power Transmission. The long distance transmission of power by electricity for use in lighting, traction, mining and manufacturing work. Comparison of electric transmission and other systems. The design, construction, maintenance and protection of lines; the effects of inductance and capacity on the operation of the power systems; the generating plant and receiving systems. Preparation required: 357 or 365, 361 or 362, 370. Second term (3).

376. Electrical Engineering Seminary. Continuation of 371. Reports on thesis work are presented and discussed. Preparation required: 371. Second term (1).

377. Dynamo Laboratory. Continuation of 368. Alternating current testing; methods of determining the regulation of alternators; tests on single-phase induction and series (commutator) motors. Fee, $12. Preparation required: 365, 366, 368. Second term (2).

378. Dynamo Laboratory. Experimental studies and tests of direct and alternating current machines. Adapted to students

who have not taken 360, 365, 366, 368. Fee, $12. Preparation required: 356. Second term (2).

379. Electrotechnology. General survey of the more important industrial applications of electricity with special reference to the requirements of mining engineering. Elementary theory of alternating currents with application to machinery; comparison of systems of power transmission and distribution; illustrative problems. Preparation required: 372. Second term (2).

380. Inspection Report. During the vacation between the Junior and Senior years each student in Electrical Engineering is required to inspect some electric railway system, lighting or power plant, or other electrical installation, and prepare a written report thereon. A descriptive outline of the installation which the student proposes to inspect must be submitted to the Professor of Electrical Engineering before July 12th, and after approval the detailed report must be handed in before September 20th. These reports should contain such calculations, photographs, drawings and plots as each individual case may require.

381. Thesis for Degree of E.E. Each candidate for the degree of Electrical Engineer is required to present a thesis upon a subject chosen by the candidate during the first term of the Senior year. The work upon which the thesis is based is done during the second term, and it consists in part of reading from references furnished by the professor in charge, and in part of independent work in theory, experimental research, or designing. Reports of progress on thesis work are required from time to time during the term. Much importance is attached to the thesis as evidence of the candidate's ability to carry out an independent investigation. Second term (3).

A fee of $6 for each term-hour (period) of dynamo laboratory work taken per term is required of each student.

For Summer Schools, see Courses 201, 350, 206, and 380, also statement on page 117.

CHEMISTRY

PROFESSOR ULLMANN, ASSOCIATE PROFESSOR BABASINIAN, ASSISTANT PROFESSOR DIEFENDERFER, ASSISTANT PROFESSOR SALISBURY, ASSISTANT PROFESSOR BECK, DR. WILSON, MR. MA GUIRE, MR. ASHBY, MR. LONG, MR. LEWIS

390. Elementary Chemistry. Description of the non-metallic and metallic elements and their compounds. Lectures illustrated by experiments, diagrams, working drawings, and specimens from

the museum. Note-books on the lectures required. Text-book: Kahlenberg's Outlines of Chemistry. First term (2).

391. Chemical Laboratory. Experiments covering a systematic study of the chemical and physical properties of the more important elements and their compounds. Text-book: Ranson's Experimental General Chemistry. First term (2).

392. Theoretical Chemistry. This course is intended for those students who have passed the examination in Elementary Chemistry held on the first Saturday of the term. Text-book: Holleman-Cooper Inorganic Chemistry. First term (2).

393. Qualitative Analysis. Practical work in the qualitative laboratory, accompanied by lectures and recitations. Text-book: Treadwell's Analytical Chemistry, Vol. I. Second term (3).

394. Stoichiometry. Chemical problems, and reactions. Text-book: Whiteley's Chemical Calculations. Second term (1).

395. Chemical Philosophy. Lecture Course. Theories of Chemistry; physical and chemical methods of determining atomic and molecular weights, radio-activity, solutions, electrolysis, dissociation, catalysis, equilibrium, thermo-chemistry, etc. Text-book: Mellor's Modern Inorganic Chemistry. First term (3).

396. Quantitative Analysis. Practical work in the quantitative laboratory, accompanied by lectures and recitations. Acidimetry, alkalimetry, chlorimetry, and the determination and analysis of simple chemical compounds and ores. Text-book: Treadwell's Analytical Chemistry, Vol. II, Fresenius's Quantitative Analysis. First term (5).

397. Quantitative Analysis. Shorter course. Practical work in the quantitative laboratory. Analysis of simple chemical compounds, ores, and metallurgical products. First term (3).

398. Quantitative Analysis Conference. Lectures and recitations concerning the laboratory work of courses 396 and 397. First term (1).

399. Quantitative Analysis. Continuation of course 397. Second term (5), (4), or (3).

400. Quantitative Analysis. Continuation of the course 396. Analysis of minerals, ores, slags, alloys, etc. Text-books: Treadwell's Analytical Chemistry, Vol. II, Fresenius's Quantitative Analysis, Blair's Chemical Analysis of Iron. Second term (6).

402. Quantitative Analysis Conference. Lectures and recitations concerning laboratory work of courses 400 and 399. Second term (2) or (1).

403. Advanced Chemistry. The elements and their compounds. Text-book: Mellor's Modern Inorganic Chemistry. Second term (3).

405. Quantitative Analysis. Continuation of course 400. Ores and alloys, complete analysis of iron and steel; also gas analysis, mineral water analysis, etc. Text-books: Treadwell's Analytical Chemistry, Vol. II, Fresenius's Quantitative Analysis, Hempel's Gas Analysis. First term (2) or (4).

407. Quantitative Analysis Conference. Discussions concerning the laboratory work of courses 405 and 408. First term (2).

408. Quantitative Analysis. Continuation of course 399. Analysis of ores and metallurgical products, and gas analysis. First term (2), (3) or (4).

409. Organic Chemistry. Lectures and recitations. Typical compounds of carbon, their classification, general relations, and methods of preparation of important compounds. Text-book: Bernthsen's Organic Chemistry, translated by Sudborough. First term (3).

410. Organic Chemistry. Laboratory work. Determinations of specific gravities, melting points, boiling points, vapor densities; quantitative determinations of carbon, hydrogen, nitrogen, and qualitative and quantitative determinations of carbon, hydrogen, nitrogen, and the halogens. The preparation of pure organic compounds. Text-books: Gattermann-Schober's Practical Methods of Organic Chemistry, Levy's Organisch-Chemische Präparate. First term (2).

411. Organic Chemistry. Continuation of course 409. Lectures and recitations. Second term (4).

412. Organic Chemistry. Laboratory work. Continuation of course 410. Practical methods of saturation, nitration, reduction, diazotisation, sulphonation, etc. Preparation of pure compounds. Study of the properties of dyes and other commercial products. Text-books: Gattermann-Schober's Practical Methods of Organic Chemistry, Levy's Anleitung zur Darstellung Organisch-Chemischer Präparate, Cohen's Practical Organic Chemistry. Second term (4), (3) or (2)..

413. Industrial Chemistry. Preparation of a number of chemically pure inorganic salts from minerals, commercial products, etc.; of various dyes and dye mixtures, and the dyeing of cotton, silk, and woolen fabrics; calico printing; fermentation; bleaching; manufacture and testing of illuminating gas, coke and by-products. Machinery of chemical industry. First term (3).

414. Assaying. Lectures and laboratory practice in the furnace assay of the ores of lead, tin, antimony, gold, silver, and iron; also gold and silver bullion analysis by processes used in the United States Mint. Text-book: Lodge's Notes on Assaying. First term (3).

415. Assaying and Industrial Mineralogy. This course covers much of the ground of course 414. In addition there is instruction and laboratory work in Industrial Mineralogy, embracing about 200 minerals and rocks. It is intended primarily for Chemical Engineers. Summer term, four weeks, beginning June 7, 1916.

416. Industrial Chemistry. Lectures on the chemical industries, illustrated by experiments, diagrams, and specimens from the museum of chemistry. Second term (3).

417. Industrial Analysis. Analysis of commercial products. Laboratory work. Text-book: Allen's Commercial Organic Chemistry. Second term (3).

418. Industrial Analysis Conference. Lectures concerning the laboratory work of course 414. Second term (1).

419. Sanitary Chemistry. Qualitative and quantitative examination of air, water, food, disinfectants, baking-powders, flour, bread, tea, coffee, cocoa, spices, milk, butter, lard, beer, and other substances connected with this branch of the science. Second term (3).

420. Physical Chemistry. Lectures and recitations. Text-book: Senter's Physical Chemistry. First term (3).

421. Physical Chemistry. Laboratory work. Determination of molecular weights and physico-chemical measurements. First term (1).

422. Thesis for Degree of B.S. or of Ch.E. A candidate for the degree of B.S. in Chemistry or of Ch.E. is required to present a thesis on some subject, approved by the Professor of Chemistry, involving practical work in the laboratory and use of the library. The thesis is regarded as part of the final examinations of the courses. Second term (3) or (6).

Deposits to cover breakage, chemicals, etc., are required in the above courses, as follows: Ten dollars each in courses 417 and 421; fifteen dollars in courses 391, 419, and 422; twenty dollars in courses 408 and 410; twenty-five dollars in courses 393, 397, 405, and 413; thirty dollars each in courses 396, 399, 400, 414, and 415; forty dollars in course 412. The unused portion of the deposit is returned to the student.

SUMMER SCHOOLS. Courses in Qualitative Analysis and Stoichiometry begin July 19, 1916, and continue four weeks. The course in Quantitative Analysis begins on the same date and continues for five weeks. The required course in Assaying begins June 7, and a second course may be given, beginning August 21. They are open to all persons prepared to take them.

PHYSICAL EDUCATION

PROFESSOR REITER, MR. CASSIDY

440. GYMNASIUM. Class exercises in the open air, consisting of setting-up work for correct carriage. Work with dumb bells, wands, and Indian clubs to stimulate circulation, respiration, muscular action, coördination and grace. Squad work on the heavy apparatus is given to develop strength in the larger muscles; recreative work in games and competitive exercises, to develop the play and combative elements. During the fall and winter Soccer Football is substituted for the regular Gymnasium work, in which the competitive element is highly developed. During the spring a Freshman Baseball Team is maintained, also the Gymnasium classes substitute this form of sport for the regular class work. All Freshmen participating in an organized sport, under the advice of the Director, are excused from the regular Gymnasium work during the period of that sport. Special instruction is also given in boxing and wrestling. Stress is laid upon athletic and æsthetic dancing. In addition to the regular required Gymnasium work, each student in order to receive credit must swim at least the length of the pool. An opportunity, under a competent instructor, is given those who cannot swim during the fall and winter months. Classes in the modern dances are held twice a week during part of the winter. Voluntary classes in Gymnasium work are conducted for upper classmen. Short talks are given to the Freshmen on personal hygiene and the physiology of exercise. Entering students are given a thorough physical examination, and special advice on postural and physical defects. Each student receives a plotted card showing him his defects and his relation to the normal student. In case any marked defects are found the student is sent to the consulting physician. The privilege of a second physical examination is given him, showing a comparative statement and plotting of his physical condition. First and second terms (2).

441. First Aid to the Injured. This course is designed to give the student a practical knowledge of the most efficient methods of giving first aid to the injured. A brief resumé of the important points in Anatomy will be taken up, followed by consideration of shock, dislocation, fractures, rabies, hemorrhage, burns, sunstroke, frost bite, electricity and lightning stroke, poisons and their antidotes, drowning, asphyxiation, railroad and mining injuries. Students will be required to do practical work in bandaging, applying splint and tourniquets, and to become familiar with the ordinary first aid materials and methods of transporting the injured. Second term (1).

442. Physical Education. Each student above the Freshman class takes a period of optional exercise, at least one hour in length, three days a week throughout the college year. If this exercise is satisfactorily done a credit of one term-hour is given and is credited as such in determining the student's general standing at the end of the term.

Students entering with advanced standing are held responsible for fulfilling the above requirement only during the terms in which they are in residence at the University, but the character of the first year's exercise is determined by the Professor of Physical Education.

CONFERENCE DEPARTMENT

PROFESSOR LAMBERT,

PROFESSOR PALMER, ASSISTANT PROFESSOR CHARLES, MR. MA GUIRE

The Conference Department provides extra instruction in Mathematics, Modern Languages, Physics, and Chemistry for Freshmen and Sophomores. Provision is made for two classes of students.

Class A. Any student who wishes to clear up some difficulty in the Mathematics, Modern Languages, Physics, or Chemistry of the Freshman or Sophomore year, should consult the teachers in the Conference Department on Wednesday and Saturday afternoons.

There is no fee for Class A students.

Class B. Students who are advised by the Dean or by the Heads of Departments or by the Committee on Standing of Students to take extra instruction in the Conference Department, or students who decide to do so of their own volition, can arrange for extra instruction for any period not less than one week by consulting the Director of this Department, who will be found in his office

in Packer Hall at 6:45 P.M. on Monday, Tuesday, Thursday, and Friday of each week. The hours of instruction are from 7 to 8 and 8 to 9 on the evenings of these four days.

The Fee of Class B Students, $1.50 for four consecutive recitations, must be paid in advance to the Bursar.

The Conference Department offers to students of the Freshman and Sophomore years an opportunity of reviewing Mathematics, Modern Languages, Physics, and Chemistry during the Christmas vacation. The fee for vacation work is the same as the fee of Class B students.

EXTENSION COURSES

During the year 1915-1916 the extension courses carried on are of three kinds:

1. Courses in the Lehigh Evening School, which is also the practice school of the Department of Philosophy and Education.

2. Evening Lecture Courses. These are of more advanced character, but those who register for them need not undertake the courses of study which are outlined in connection with them.

3. Courses certified to be of college grade. This year the following courses are given:

SUMMER SCHOOLS

The Summer Schools in shop inspection and sketching of machine parts, at the end of the Freshman year in the courses of Mechanical Engineering, Electrical Engineering, Metallurgical Engineering, Electrometallurgy, Mining Engineering, and Chemical Engineering, and in Mechanical Technology at the end of the Sophomore year in these courses with the exception of the Mining Engineering and Chemical Engineering courses, the Summer School in Topographic Surveying in the courses of Civil Engineering and Mining Engineering at the end of the Sophomore year, the Summer School in Assaying in the course in Chemistry at the end of the Sophomore year, the Summer School in Assaying and Industrial Mineralogy in the course of Chemical Engineering, the Summer School in Mine and Railroad Surveying in the course of Mining Engineering at the end of the Junior year, and also the Summer School in Engineering Laboratory in the courses of Mechanical Engineering and Chemical Engineering at the end of the Junior year are required studies and are therefore to be reregarded as the Summer terms of these courses. Likewise the in-

struction in Land Surveying at the end of the Sophomore year is required of the students in the course of Mining Engineering, but is extra for the students in the course of Civil Engineering at the end of the Freshman year, for the reason that this subject is regularly scheduled in the second term of the Sophomore year, and students desiring to take it out of the regular course pay for it as an extra. Students not connected with the University may be admitted to the courses in Surveying if properly qualified. For this purpose special arrangement must be made with the Professor of Civil Engineering for the courses in Land and Topographic Surveying, and with the Professor of Mining Engineering for the course in Mine and Railroad Surveying.

In addition to this required Summer work, there are also Summer Schools in Mathematics, Mechanical Drawing, Chemistry, Physics, German, French, Mineralogy, and Metallurgy designed primarily for students of the University who are deficient in these subjects. But others not connected with the University may be admitted if properly qualified. These last mentioned Summer schools, with the exception of the Summer schools in Chemistry, begin in August; the Summer schools in Chemistry begin on July 19. A special circular giving details, fees required, etc., will be sent to those applying for it.

GRADUATE COURSES

The degree of Master of Arts is conferred upon any candidate, otherwise properly qualified, who, after having taken the degree of Bachelor of Arts at any college or university, shall pursue for at least one year at this University a course of liberal study in two departments (under two professors), pass the examinations of the same, and present a satisfactory thesis.

The degree of Master of Science is conferred upon any candidate, otherwise properly qualified, who, after having taken the degree of Bachelor of Science or a degree in technology at any college or university, shall pursue for at least one year at this University a course of advanced study in two departments (under two professors), pass the examinations of the same, and present a satisfactory thesis.

In exceptional cases candidates for the Master's degree will be allowed to study in absentia. Candidates who spend only a part of their time in study are expected to take at least two years to complete their work.

The tuition fee is $50 a year and the graduation fee is $10. No tuition fee is charged to students pursuing graduate work in nonresidence, but the graduation fee is $30, and at least two years are required to complete the course.

The course of study may be selected with the approval of the Faculty, at least fifteen exercises per week being chosen in two departments. About two-thirds of the work is to be in one department, called the major department, and is to be chosen from the following list of subjects. About one-third of the work is to be in another department, called the minor department, and may be chosen from the following list of subjects or from other courses offered in the University which present an advanced stage of study, and which are approved in the case of each individual applicant by the Committee on Higher Degrees. The thesis is to be prepared on a subject connected with the studies of the major department. The candidate is required to satisfy each professor concerned that he is fully competent to pursue the subjects selected.

Candidates who desire to receive the Master's degree in June, 1917, are required to confer with the professors on or before September 16, 1916, and to present their courses of study to the Faculty for approval on October 2, 1916.

The following subjects are now offered by the University; other allied subjects may in some cases be selected by candidates after conference with the professors in charge.

MATHEMATICS AND ASTRONOMY

Practical Astronomy

PROFESSOR THORNBURG, PROFESSOR OGBURN

The work embraces: (*a*) The study of instruments and methods used in the determination of time, latitude, longitude, and azimuth; (*b*) Practical work in the observatory, securing facility in making and reducing observations. Two terms (5).

Differential Equations

PROFESSOR LAMBERT

The course in Differential Equations is based on Johnson's Differential Equations and Byerly's Spherical Harmonics. Collateral reading in the University Library is required. Two terms (3).

Analytic Mechanics

ASSISTANT PROFESSOR REYNOLDS

Elementary and Advanced Rigid Dynamics; Potential Functions, based on Love's Theoretical Mechanics; Williamson and Tarletan's Dynamics; and Routh's Dynamics. Two terms (3).

Differential Geometry

MR. KNEBELMAN

Parametric representation of plane and skew curves and surfaces, theory of contact, curvature, differential invariants, intrinsic equations, trajectories, equations of Césaro, curvilinear coordinates, equations of Lamé. Representation of one plane upon another, conformal and spherical representation, equations of Gauss and Godazzi, theory of applicability. Two terms (2).

ENGLISH

English Literature

PROFESSOR THAYER

An advanced course in branches which have not formed a part of the undergraduate work of the candidate, the details of which will be arranged after a personal conference. Two terms (5).

Anglo-Saxon

ASSISTANT PROFESSOR MESCHTER

Anglo-Saxon poetry and prose above the grade of undergraduate work, from both the literary and the historical point of view. Two terms (5).

English Philology

ASSISTANT PROFESSOR LUCH

An advanced course in the principles of Teutonic philology as applied to the origin and development of the English language. Two terms (5).

Sanskrit

PROFESSOR THAYER

Beginners' Course. Perry's Primer. Lanman's Reader. Whitney's Grammar. Two terms (5).

ECONOMICS AND HISTORY

Political Economy

PROFESSOR STEWART

This course embraces: (*a*) The rise and development of economic systems and economic thought. (*b*) The scope and method of political economy. Patten's Development of English Thought and the works of Keynes, Cohn and Ingram on Political Economy will be used. Two terms (5).

American History

PROFESSOR STEWART

An examination of the influence of the economic development of the Union upon the legal and political theories incorporated in the Constitution. Two terms (5).

Politics

PROFESSOR STEWART

The history of the attempt to treat in a systematic way the problems of political organization. Pollock's History of the Science of Politics and Sidgwick's Elements of Politics. Two terms (5).

LATIN

PROFESSOR BLAKE

An advanced course in the Latin language and literature. The course will be arranged with each candidate individually upon application. Two terms (5).

GREEK

Advanced courses, of which the following are specimens, will be arranged upon application.

Hellenistic Greek

PROFESSOR GOODWIN

Gospel of St. Mark, Acts, and selected Epistles of the New Testament. Thayer's Lexicon. Blass's Grammar of New Testament Greek. Patristic literature. Collateral reading. Selections from Lucian. Two terms (5).

Dramatic Poetry

PROFESSOR GOODWIN

Several plays of Aeschylus, Sophocles, Euripides, and Aristophanes. Aristotle's Poetics. Collateral reading. Two terms (5).

Greek Philosophy

PROFESSOR GOODWIN

Plato's Republic and other works. Aristotle, selections. Ritter and Preller's Historia Philosophiae Graecae. Zeller's History of Greek Philosophy, and other collateral reading. Two terms (5).

ELECTRICAL ENGINEERING

Theory of Alternating Currents and Alternating Current Machinery

PROFESSOR ESTY

This course is based upon the works of Arnold, Bedell and Crehore, Steinmetz, and Franklin and Esty. Two terms (4).

Electrical Design

PROFESSOR ESTY

This course consists of predeterminations by calculation of the characteristics, regulation and performance of electrical machinery. Analysis and use of designing constants. Design of special machines. Two terms (3).

Electric Traction

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT

The development of an electric railway project. Design of station and distribution system. Operating characteristics of direct and alternating current railway motors. Predetermination of motor equipment and run curves for given schedules and traffic. Choice of system. Estimates of cost. Two terms (3).

Electrical Testing

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT

Special experimental research in electrical engineering; tests of the magnetic properties of iron and steel; investigation of the series single-phase alternating current motor; leakage reactance of induction motors; regulation of alternators; polyphase testing; electric railway testing. Two terms (3).

METALLURGY

Thermo-Chemistry and Thermodynamics of the Metals

PROFESSOR RICHARDS, ASSISTANT PROFESSOR ROUSH

A study of the melting points, boiling points, specific heats, and latent heats of fusion and of vaporization of the metals, from a practical and theoretical standpoint. Also, of the heats of formation of compounds of the metals, and the relations of these to atomic weights and other chemical and physical properties. Lectures and laboratory work. First term (5).

Thermo-Chemistry and Physics of Metallic Alloys

PROFESSOR RICHARDS, ASSISTANT PROFESSOR ROUSH

A study of the physical and chemical properties of metallic alloys, their melting points, specific heats, latent heat of fusion, heats of formation and microscopic structure. Lectures and experimental work in the same. Second term (5).

Electrometallurgy

PROFESSOR RICHARDS, ASSISTANT PROFESSOR ROUSH

A study of the conditions of deposition of metals and alloys in electrolysis, electrolytic separations, formation of metallic compounds by electrolysis, energy absorption in electrolysis. Lectures and laboratory work. First term (5).

MINING ENGINEERING

Mining Engineering

PROFESSOR ECKFELDT

The study of methods used in a given mining region, or in the production of a given class of mineral, with respect to conditions influencing choice of method and cost. Two terms (5).

Mining Plant

PROFESSOR ECKFELDT, MR. SMITH

The determination of the efficiency of mining machinery of given types under varying conditions. Two terms (5).

Ore Dressing Plant

PROFESSOR ECKFELDT, MR. BARTLETT

The study of certain operations incident to the dressing of ores or the preparation of coal. Determination of efficiency of machines and processes. Losses in dressing. Two terms (5).

GERMAN

German

PROFESSOR PALMER

Lessing's Life and Works. Lectures, reading and reports on assigned work. First and second terms (3).

Middle High German. Wright's Middle High German Primer. Bachmann's Mittelhochdeutsches Lesebuch. Nibelungenlied. First term (3).

Middle High German. Gudrun, Wolfrom von Eschenbach, Gottfried von Strassburg, Walther von der Vogelweide. Lectures on Middle High German literature. Second term (3).

GEOLOGY

Geology

PROFESSOR MILLER

The investigation and study of the literature of some special geological problem. This will comprise field and laboratory work on some district in the vicinity of the University. A map of a limited area will be constructed, the microscopic character and general structural features of the rocks which are exposed will be investigated and a thesis or dissertation embodying these results will be presented. Preparation required will depend upon the nature of the problems to be studied. Two terms (4).

Economic Geology

PROFESSOR MILLER

Advanced work in ore deposits. Study of the literature and of the theories of ore deposition, together with detailed work on the type occurrences of some one of the metallic or non-metallic minerals. The student will be required to make a thorough investigation and report on some mining district with special regard to the origin of the ores and such commercial aspects of the deposits as may depend chiefly on the geology. Preparation required: 270 or 271. Two terms (6).

Petrography

ASSISTANT PROFESSOR HINTZE

A critical study of recent advances in petrographic methods and nomenclature. Preparation of a detailed report on a selected problem. Preparation required: 267, 269, 271, 272, 274, 278, and 279. Second term (3).

Physiography

PROFESSOR MILLER

The detailed study of physiographic types and processes. Conferences, reports and theses, with work in the laboratory and field. A training in elementary physiography (such as is given in 277) together with some knowledge of general geology is essential. Two terms (4).

Physical Crystallography

ASSISTANT PROFESSOR HINTZE

An advanced course in the geometrical and physical properties of crystals, with special reference to the Goldschmidt methods of crystal measurement and projection. First term (4).

CIVIL ENGINEERING

Bridge Design

PROFESSOR MC KIBBEN

The theory of suspension and arched structures, with the preparation of general plans and estimates, and the economic comparison of different types. Two terms (4).

Testing of Materials

PROFESSOR MC KIBBEN

The properties of materials of construction, with special reference to inspection and testing. The student will conduct original researches in the laboratory. The work on the unification of methods of testing done by the International Association for Testing Materials will receive detailed attention. Two terms (5).

Railroad Engineering

PROFESSOR WILSON

The economic location of railroads, as influenced by probable volume of traffic and cost of operation. A course based on Wellington's treatise, with the detailed discussion of special cases. Two terms (2).

Sanitary Engineering

MR. FOX

The designing of reservoirs, tanks, and pipe lines for water supply systems, and of sewers and other appurtenances for sewerage systems. Inspection of existing plants, with reports thereon. Two terms (4).

BIOLOGY

Vertebrate Histogenesis and Organology

PROFESSOR HALL

Lectures, reading, and laboratory work. In the laboratory the development of a vertebrate will be carefully followed, tracing the history of the germ-layers, organs, and tissues. The organology deals with the association of tissues to form organs. Preparation required: 292, 293, 294. First term (3).

PHILOSOPHY, PSYCHOLOGY, AND EDUCATION

PROFESSOR HUGHES

The following undergraduate courses may count towards an advanced degree provided additional work be taken in connection with them: History of Philosophy, ancient and modern, History of Education, Educational Psychology, Principles and Practice of Teaching, and Psychological Studies. More advanced courses, in Education, in Psychology, in Logic, Ethics and Metaphysics, may be outlined to meet the needs of competent students.

FRENCH

PROFESSOR FOX

An advanced course in the French language and literature. The course will be arranged with each candidate individually upon application. Two terms (5).

CHEMISTRY

Advanced Industrial Chemistry

PROFESSOR ULLMANN, ASSISTANT PROFESSOR SALISBURY

This course involves the study of some industry dependent upon chemical principles and consists of experimental and analytical work in the laboratories, inspection of manufacturing establishments, and study of the technical journals and other publications. Two terms (10).

Advanced Organic Chemistry

ASSOCIATE PROFESSOR BABASINIAN

This course consists of original investigations in organic chemistry. Two terms (10).

Advanced Analytical Chemistry

PROFESSOR ULLMANN, ASSISTANT PROFESSOR DIEFENDERFER

Study and comparison of known methods of quantitative analysis and the development of new methods. Two terms (10).

Physical Chemistry

DR. WILSON

This course consists of original investigations in physical chemistry. Two terms (10).

PHYSICS

Theoretical Physics

PROFESSOR MAC NUTT, ASSISTANT PROFESSOR CHARLES

Elective courses are offered in the following subjects: (*a*) The Theory of Heat, based upon Preston's Theory of Heat, Buckingham's Thermodynamics, and Nernst's Theoretical Chemistry; (*b*) The Theory of Electricity and Magnetism, based upon Maxwell's Treatise, J. J. Thompson's Recent Researches, and Conduction of Electricity Through Gases, and Hertz's Electric Waves; (*c*) The Theory of Light, based upon Preston's Theory of Light, Drude's Theory of Light, Wood's Physical Optics, and Michelson's Light Waves and Their Uses. First and second terms (3) to (5).

Physical Research

PROFESSOR MAC NUTT, ASSISTANT PROFESSOR WILY

Advanced students are given an opportunity to pursue experimental investigations in physics. First and second terms (2) to (4).

TUITION AND OTHER FEES

For students in the courses of Civil, Mechanical, Metallurgical, Mining, Electrical, and Chemical Engineering, and Electrometallurgy, the tuition fee is $200 for the year or $120 for either term; for students in the course of Chemistry and in the courses leading to the degree of Bachelor of Science, $150 for the year or $90 for either term; for students in the course leading to the degree of Bachelor of Arts, $100 for the year or $60 for either term. The

tuition rate in the course of Chemistry is lower than that of the other technical courses on account of cost of materials used in the laboratories, which are furnished to the students at wholesale prices. The tuition for the subjects offered in the Summer term immediately following Commencement Day is $20. No charge is made for such subjects to students who have paid tuition for the previous year, provided the subjects in question are a scheduled part of the technical courses they are pursuing. A graduation fee of $10 is paid by all candidates for a degree. A registration fee of $10 is paid by each student yearly when he enrolls. Of this, $8 is paid to the Athletic Association and entitles the student to admission to all athletic contests held at the University; $2 is applied to the maintenance of Drown Memorial Hall, a building devoted to the convenience and pleasure of the student-body (see page 140). This registration fee was imposed at the request of the student-body.

The tuition fees are payable to the Bursar of the University in two instalments, on the opening day of the college year in September, and on the first day of the second term in February. The first installment is $120, $90, or $60, according to the course, and the second $80, $60, or $40. Application may be made for a return of part of the tuition fee when a student has formally withdrawn from the University after less than four weeks' attendance in either term, but the amount thus refunded will in no case exceed one-half of the last instalment paid.

Students who fail to pay tuition fees when due will be notified that their attendance at college exercises must be discontinued until payment is made.

EXPENSES

Books, stationery, and drawing instruments may be obtained by students at low prices at the Supply Bureau in Drown Memorial Hall. For work in the laboratories, materials may be obtained from the University, students making a deposit at the opening of the term covering the value of the materials. The amounts of these deposits are given under the detailed statement of laboratory courses in the List of Studies.

The University affords residence and board for those desiring to live on the campus. Single rooms in the dormitories, where 174 students are domiciled, rent at $65 a year; suites of three or four rooms rent at $81 for each occupant. Students desiring it

may obtain table board at the College Commons at $15 for thirty consecutive days, or $4 for a single week. Numerous private householders in the Bethlehems offer rooms and board at moderate rates.

Necessary expenses for the collegiate year, clothing and traveling not included, are estimated at $300 to $400 in addition to tuition. This includes attendance at the required Summer schools.

SITE

South Bethlehem is situated at the junction of the Lehigh Valley, the New Jersey Central, and the Philadelphia and Reading Railroads, and the University buildings are about a half-mile from the station. New York is eighty-six and Philadelphia fifty-seven miles distant.

The situation of the institution is healthful and beautiful. The region is famous for its mines and its railway and manufacturing enterprises.

BUILDINGS

PACKER HALL

Packer Hall, completed in 1869, is four stories in height, 215 feet long, and 60 feet wide. It is built of Potsdam sandstone in the English Gothic style of architecture, and occupies a commanding position, overlooking Bethlehem and South Bethlehem.

The department of Civil Engineering occupies the greater part of the first and second floors of Packer Hall. On the first floor are a lecture room, two recitation rooms, a large drawing hall, two instrument rooms, two offices and a library room, and a shop equipped with a small lathe and other tools for use in repairing surveying instruments. The instrument rooms contain seventeen transits, fourteen levels, a large geodetic theodolite, two plane tables, and other instruments for engineering field work. In the library room is an excellent collection of plans of engineering structures. On the second floor are two drawing rooms, three recitation rooms, an instrument room, a blue-print room, and offices.

On the third and fourth floors are to be found the offices and recitation rooms of the department of Mathematics and Astronomy.

THE CHEMICAL AND METALLURGICAL LABORATORIES

The Chemical and Metallurgical Laboratories are contained in a fire-proof building, built of sandstone, 219 feet in length by 44 in width, with a wing.

In the Chemical department there are two principal stories and a basement. The upper floor is occupied by the quantitative and the qualitative chemical laboratories. These rooms are 22 feet in height, and are well lighted and ventilated. Laboratories for industrial chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a smaller lecture room, a recitation room, a chemical museum, and laboratories for organic, physical, and sanitary chemistry.

In the basement is a large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis; also rooms containing the apparatus for several processes in industrial chemistry, the engine and air pump for vacuum filtration, etc.

The Metallurgical department contains a lecture room, a blowpipe laboratory for class instruction in blowpipe analysis; a museum of metallurgical collections; a laboratory provided with a spectroscope, a simple and a polarizing microscope, two Le Chatelier microscopes complete with camara; a dry laboratory provided with furnaces for solid fuel and for gas, with natural draught and with blast, electric current for electrometallurgical experiments, and a wet laboratory for ordinary analytical work. Equipment is provided for laboratory work in metallurgy, in metallography, and particularly in electrometallurgy, consisting of working places for students, each equipped with gas, electric current, and apparatus for various kinds of experimental work; and several new pyrometers, calorimeters, and furnaces have been added to the general equipment. These departments are therefore well arranged and equipped for the instruction of classes in the courses of metallurgy, electrometallurgy, and blowpipe analysis of the regular curriculum, and to afford facilities to students for familiarizing themselves with the methods of measurement and research employed in metallurgy and electrometallurgy, and for conducting original investigations in these departments of science.

THE PHYSICAL AND ELECTRICAL LABORATORY

The Physical and Electrical Engineering Laboratory is 240 feet long, 44 to 56 feet wide, and four stories high. The halls and stairways, the photometer rooms, and all apparatus rooms are of fire-proof construction. The remainder of the building is of heavy mill construction.

On the first floor are the Advanced Electrical Laboratory and shops of the Physics department, the Senior and Junior dynamo laboratories, the shops, and research room of the Electrical Engi-

neering department, and a storage battery room belonging jointly to the departments of Physics and Electrical Engineering.

The dynamo laboratory for Senior students in the west wing is supplied with power from a 75-kilowatt rotary converter receiving current from the University power plant through two 30-kilowatt transformers. The dynamo laboratory equipment, which is being constantly increased, now includes the following apparatus: an 18-kilowatt double current generator, two direct current motor-generator units, one Lincoln variable speed motor, a 4-kilowatt Westinghouse two-phase rotary converter, a 10-kilowatt General Electric six-phase compound rotary converter, two direct connected units consisting of 7½-kilowatt six-phase General Electric alternators driven by 15-horse power Allis-Chalmers motors, one 20-kilowatt two- (or three-) phase alternator built by the Department, a 35-kilowatt Westinghouse single-phase alternator, a 10-kilowatt composite wound alternator driven by a 15-horse power Crocker-Wheeler motor, a pair of 3-horse power direct connected series crane motors, three motor-generator sets converting from alternating to direct current, four induction motors ranging from 7½-horse power to 2-horse power, twenty-two transformers of from 1 to 15-kilowatts, including two 15-kilowatt Scott-connected transformers, a 5-kilowatt 66,000-volt testing transformer, a 6-light constant current transformer, a 30-ampere arc rectifier outfit complete, a General Electric oscillograph outfit, and a variety of instruments, including voltmeters, ammeters, watt-meters, rheostats, contact makers, frequency meters, dynamometers, condensers, and other apparatus.

The dynamo laboratory for Junior students on the first floor in the west wing contains the following apparatus: a 20-kilowatt Ferranti alternator driven by a direct current motor, two arc light machines, twenty arc lamps of various types, a Brackett cradle dynamometer, a Westinghouse two-phase rotary converter, a motor driven battery-booster set, several types of adjustable speed motors, and other motors for direct and alternating currents.

On the second floor are the offices of the departments of Physics and of Electrical Engineering, two general apparatus rooms, a large laboratory room for Physics, a large dynamo laboratory for Sophomore students in Electrical Engineering, and an Electrical Engineering reading room. The dynamo laboratory for Sophomore students in the west wing is equipped with twenty-seven direct current machines of various types. Apparatus exemplify-

ing the operation of telegraph, telephone, and wireless telegraph stations are here installed.

On the third floor are the lecture room, apparatus rooms and photometer rooms of the department of Physics, and lecture room, recitation rooms, apparatus room, and drawing room of the department of Electrical Engineering.

On the fourth floor are recitation rooms and two large laboratory rooms of the department of Physics. A large room for Free-hand Drawing is located on this floor.

THE W. A. WILBUR ENGINEERING LABORATORY AND POWER HOUSE

The laboratory portion of this building was erected in 1902; in 1907 the original building was doubled in size, the addition containing the new heating and lighting plant of the University. The building is of sandstone, conforming in material to the adjacent Chemical and Physical Laboratories. It is 44 feet wide by 188 feet long, one story high in the boiler room, but with a raised engine room forming a second story at either end.

The boiler equipment of the laboratory consists of two water-tube boilers rated at about 100-horse power each, one of Babcock & Wilcox type, the other of Stirling make. In the heat and light plant there are three 250-horse power Stirling boilers, with room for a fourth unit of equal or greater capacity. Each section has its own set of feed pumps and other auxiliaries, in the arrangement of which special provision has been made for easily conducting performance tests. The laboratory boilers are connected to the chimney of the old boiler house, and have also an induced draft outfit. The chimney of the newer plant is of a radial brick construction, 125 feet high, and a forced draft equipment is to be installed when need for increased capacity arises.

A coal-storage yard north of the building has room for a season's supply of coal, and a system of belt-conveyors and bucket-elevator is provided for receiving coal, dumping it on storage pile, and conveying it into the boiler room as needed.

The engine room of the laboratory, 50 feet long, contains a vertical triple-expansion engine of 75-horse power, a 60-horse power compound two stage Ingersoll air compressor, a small tandem-compound yacht engine, a simple Ball engine direct connected to a 25-kilowatt Crocker-Wheeler generator, and a 5-horse power De Laval steam turbine. There is also a complete set of Westinghouse air-brake apparatus, with four freight car brakes. The air-

brake pump and all the other steam motors, including the feed and condenser pumps, are piped to the surface condensers beneath the engine room floor. There are two large condensers of 150 and 60-horse power capacity respectively, with smaller ones for the pumps and for special experiments. Besides the various engines there is a large belt dynamometer, apparatus for testing gauges, indicators, thermometers, steam calorimeters and other instruments, and for experiment on flow of steam, for testing injectors, etc. The exhaust system includes a Cochrane feed-water heater of 250-horse power capacity.

The engine room of the power house is 31 feet long, with concrete floor. The generating units now installed are of 50 and 100-kilowatt rating, and there is room for a third of larger size. Simple horizontal Ball engines are direct connected to General Electric alternating current generators, which furnish 60-cycle two-phase current at 2200 volts for transmission to the various distributing centers. An engine-driven and a motor-driven exciter, with the switchboard, complete the electrical equipment. The engines exhaust through a Cochrane heater, and the exhaust steam is discharged directly into the low-pressure system during the heating season.

The abandonment and dismantling of the old boiler plant rendered available for laboratory use a floor space 45 feet by 70 feet in the old boiler house. This now contains a 150-horse power suction gas producer for anthracite coal and is also used for apparatus and experiment in gas-power engineering and hydraulics, and for a number of the minor thermodynamic experiments with steam.

This building bears the name of W. A. Wilbur in grateful recognition of the work he has done for Lehigh University.

WILLIAMS HALL

Williams Hall was the donation of Dr. Edward H. Williams, jr., of the Class of '75, and was so named by the Trustees of the University not only in recognition of this gift but also of Dr. Williams' long continued and important services to the University as an Alumnus and as Professor of Mining and Geology.

Williams Hall is 186 feet long by 70 feet wide and covers a ground area of over 12,000 square feet. One-half of the building is devoted to the department of Mechanical Engineering and the other half to Geology and Biology.

In the eastern end are located the recitation rooms, instructors' offices, drawing rooms, reference library, and store rooms of the department of Mechanical Engineering, and in the basement rooms and apparatus are provided for laboratory work in experimental mechanics and engineering physics, such as the calibration of the measuring instruments used in Mechanical Engineering, the determination of the mechanical efficiencies of hoisting and other gear, and the testing of motors. In this section there are electric motors, a water motor, a 15-horse power centrifugal pump, hoists, blocks, jacks, and dynamometers of various kinds.

In the west end the department of Geology has on the first floor two lecture rooms, two offices, library, mineralogical museum, and laboratory of petrology and petrography. The lecture rooms contain specimens of rocks and fossils and a collection of economic minerals and ores. The main lecture room is fitted with a stereopticon for illustrated lectures. The laboratory of petrography is provided with fifteen high-grade petrographic microscopes, and study collections of rocks and minerals. The collection of rocks contains over six thousand specimens from type regions in different parts of the world. The mineralogical museum contains many valuable collections representing all the prominent mineral localities of the world. In the basement are the mineralogical laboratory, the blow-pipe laboratory, a small chemical laboratory for analytical work, and a room fitted with apparatus run by a one-horse power motor for cutting thin sections of rock. On the second floor is the paleontological museum, which contains the fossil collections. On the third floor is a room fitted as an office and laboratory, containing a Goldschmidt's two-cycle goniometer and other apparatus for advanced work in crystallography.

On the third floor are located the drawing room and an office of the Mining department, also well-equipped blue-print and dark rooms and a photographic laboratory used jointly by the departments of Mining and Geology.

The department of Biology has its lecture room, office, reference library, laboratories, and store rooms on the second floor, and a large vivarium on the third floor. The laboratories of this department are thoroughly equipped with collections, sections, microscopes, and necessary appliances.

Two students- rooms, used by the Mining and Geological Society and by the Mechanical Engineering Society, are located in the basement.

THE FRITZ ENGINEERING LABORATORY

Realizing the great need of an adequate laboratory for the testing of materials, the eminent engineer, the late John Fritz, of Bethlehem, known as the father of the steel industry in the United States, and a member of the Board of Trustees dating from the founding of the University, donated to the University the funds for the erection and thorough equipment of an engineering laboratory. The building was designed and erected under the personal supervision of Mr. Fritz. It has been named by the Trustees "The Fritz Engineering Laboratory." The building is equipped with a general testing section for testing iron and steel, a cement and concrete section, and a hydraulic section. The equipment is used by the Civil Engineering Department in connection with courses in Strength of Materials, Hydraulics, and Cement. Any student in the University who has the proper preparation may receive instruction in this laboratory.

The building is of modern steel frame construction, 94 feet wide and 115 feet long, with the main central section 65 feet in height, and two side sections of lesser height. The external walls which enclose the steel frame are of cement brick lined on the inside with red brick. A traveling crane, operated by electricity and of 10 tons capacity, commands the entire central portion of the building in which the testing of large specimens is carried on.

The general testing section is equipped with an 800,000-pound Riehlé vertical screw testing machine, capable of testing columns 25 feet long or less, tensile specimens 20 feet long or less, and transverse specimens up to lengths of 30 feet; an Olsen universal testing machine of 300,000 pounds capacity; smaller machines for ordinary tension, compression, transverse and torsion tests; a cold-bend testing machine, and a small machine shop. The hydraulic section occupies the east end of the main room and is equipped with various tanks, weirs, pumps and other apparatus for studying problems in Hydraulics. The cement and concrete section has one large room for the making and testing of specimens and one room for the storage of materials.

THE ECKLEY B. COXE MINING LABORATORY

The Eckley B. Coxe Mining Laboratory is situated south of Williams Hall and is of dressed sandstone. It is 100 feet long by 75 feet deep, one story high in the front with a raised floor in the rear.

The main part of the building contains the Ore Dressing Laboratory, 40 feet by 70 feet; the west wing contains a chemical laboratory, an assay room, a balance room, and a laboratory for testing samples; the east wing contains the office, recitation room and an instrument room. A locker and wash room is located in the basement of the east wing.

The equipment for the main laboratory, most of which was made by the Allis-Chalmers Co., consists of a gyratory crusher, rolls, screens, jigs, Huntington mill, classifiers, concentrators (tables and vanner), gravity stamps, amalgamating plates, grinding pan, and cyanide plant, with the necessary apparatus including grizzly, elevators, feeders, sand-pumps, settling tanks, zinc boxes, filter press, dryers, crawls, blocks, and electric motors. The laboratory for testing samples contains a small jaw crusher, a small gyratory crusher, rolls, sample grinder, a magnetic separator, and a small air compressor.

The machinery is driven by seven separate motors, and any one part or all of it can be operated at will, thus enabling experimental studies and tests to be made of individual machines or groups of machines, or of an entire process, as occasion may require. A round thirty-six inch water-jacketed smelting furnace is located outside of the building.

In this way the entire plant is made flexible and enables combinations of processes in order to determine the best possible method to pursue in the treatment of gold and silver ores, both free milling and sulphides, by amalgamation and cyanide processes, and of lead, copper, zinc, iron ores, etc., and of coals, by coarse and fine concentration.

Flotation of Ores. Owing to the prominence which flotation methods have assumed in Ore Concentration, it has seemed advisable to equip a special department of the main laboratory for this work, and four types of testing machines have been installed, together with the necessary equipment of motors, etc., for their operation.

The following equipment, consisting of large and small size Ingersoll-Rand Rock Drills, Stoper and Jackhammer Drills, an Ingersoll-Rand Pick Machine for coal mining, a Water-Leyner Rock Drill, a Sullivan hand-power diamond drill machine, and a Temple-Ingersoll electric-air drill, is housed in this building, also a full size mine car, a section of track on steel ties and several sets of steel mine timbers.

This laboratory has been named by the Trustees of the University "The Eckley B. Coxe Mining Laboratory" in memory of one who was universally recognized as a pioneer and a leader in the profession of Mining Engineering in this country and who was an active friend and valued Trustee of the University from its early days until his death. It is highly fitting that the Engineering and Mining Laboratories of Lehigh University should bear the names of John Fritz and Eckley B. Coxe, and that the record of the friendship and close association of these two great engineers in their life-time, and their active interest in Lehigh, should be perpetuated by these buildings bearing their names.

SAUCON HALL

Extensive alterations to Saucon Hall were made in 1896, adapting it to the needs of the department of English. It contains a study and a recitation room for each instructor, a lecture hall seating 200 persons, and a large room on the ground floor which has been fitted up for the use of the literary societies, with committee rooms adjoining.

CHRISTMAS HALL

Christmas Hall is the oldest in service of all the University's plant, being the first erected on the campus. Several classes of the Lehigh Evening School meet in this building. These classes, attended by young men from this vicinity, give practice in teaching to students in Education.

COPPÉE HALL

Coppée Hall, formerly the Gymnasium, was completely renovated in 1913 to adapt it to the needs of the Department of Arts and Science. On the first floor is a large lecture room, the office and recitation rooms of the Department of Economics, and accounting rooms for instruction in Business Administration. On the second floor are the offices and recitation rooms of the Departments of Latin, Greek, German, Romance Languages, Philosophy and Education. The Psychological Laboratory, also situated on the second floor, is equipped for elementary instruction and experimentation in the psychology of sense and movement. On the third floor are the library and seminar room of the Department of Arts and Science, also a large room for a museum and art gallery.

The building has been named by the Trustees of the University "Coppée Hall" in memory of Henry Coppée, M.A., LL.D., the first President of the University, who served in that capacity from the establishment of the University in 1866 to 1874; he retained his active connection with the University as Professor of English Literature, International and Constitutional Law and the Philosophy of History up to his death in 1895. It is eminently fitting that the headquarters of the Department of Arts and Science should bear the name of one who served the University with such distinguished reputation for scholarship and who left on the University a lasting imprint of his individuality as a man of letters.

SAYRE OBSERVATORY

By the liberality of the late Robert H. Sayre, Esq., one of the Trustees of the University, an Astronomical Observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

The Observatory contains an Equatorial Telescope, by Alvin Clark, of six inches clear aperture and of eight feet focus; a Zenith Telescope, by Blunt; a Superior Astronomical Clock, by William Bond & Son; a Meridian Circle; a Prismatic Sextant, by Pistor and Martins; and an Engineer's Transit and a Sextant, by Buff and Buff.

Students in practical astronomy receive instruction in the use of the instruments and in observation.

The land upon which the Observatory stands, consisting of seven acres adjoining the original grant, was presented to the University by the late Charles Brodhead, Esq., of Bethlehem.

Sayre Observatory Annex

Sayre Observatory Annex contains a modern zenith telescope of four and one-half inches clear aperture equipped with electric illumination. The building and instruments were presented to the University by the late Robert H. Sayre, Esq., July 23, 1903.

Observations secured with this instrument are for the purpose of investigating the Variation of Latitude.

THE PACKER MEMORIAL CHURCH

The Packer Memorial Church, in which daily chapel exercises are held, was the munificent gift of the late Mrs. Mary Packer Cummings, daughter of the Founder of the University. It was built in 1887 and is one of the largest churches in the State. During 1909-10 it was thoroughly renovated; the walls were newly

frescoed, new stained glass windows put in place, and electric lights installed. These improvements were made possible by the continued generosity of the donor, Mrs. Cummings.

THE UNIVERSITY LIBRARY

The Library building was erected by the Founder of the University in 1877, at a cost of $100,000, as a memorial of his daughter, Mrs. Lucy Packer Linderman.

The building is semi-circular in plan, with a handsome façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior the center is occupied by a reading space, 40 by 50 feet, from which radiate the book cases, extending from floor to ceiling; two galleries affording access to the upper cases. Shelf room is now provided for one hundred and sixty thousand volumes. The building is thoroughly fire-proof, well-lighted, and heated by steam.

One hundred and thirty-seven thousand volumes are now upon the shelves, including many extremely valuable books. The list of periodicals numbers about four hundred, embracing as far as possible all departments of knowledge.

The Library is open from 8 A.M. to 6 P.M., except Sundays and holidays.

The free use of the Library, with the privilege of taking out books, is offered to students of every department on presentation of their registration cards. The use of the books and of the periodicals within the building is free to all persons. Resident graduates of the University have the full use of the Library on payment of three dollars annually. Any person, pursuing systematic investigation in any study, may be allowed the full use of the Library for a period not exceeding three months without fee. At the discretion of the Director, a deposit may be required when books are issued.

The Eckley B. Coxe Memorial Library

In memory of the Hon. Eckley B. Coxe, who was for many years a Trustee of the University and who was profoundly interested in its welfare, Mrs. Coxe presented to the University his technical library, consisting of 7727 volumes, together with 3429 pamphlets. As the working library of a man who was remarkable as well for the breadth of his culture as for the extent and thoroughness of his acquaintance with the whole field of applied science, this addition to the resources of the University possesses the greatest value for all professional students.

TAYLOR HALL AND PRICE HALL

Taylor Hall, the gift of Mr. Andrew Carnegie, is a commodious concrete Dormitory situated in the University Park, south of Packer Hall, and contains rooms suitable for the accommodation of about 140 students with suites of three rooms, a study and two adjacent bed rooms, for two occupants, and a few single rooms. The building was named Taylor Hall by Mr. Carnegie in honor of Charles L. Taylor, his former partner in business, a graduate of the University in the Class of '76 and a Trustee of Lehigh.

Price Hall, a second dormitory located south of Williams Hall, accommodates 34 students. The building bears its name in honor of Dr. Henry R. Price, an honored alumnus of the University of the class of 1870, and President of the Board of Trustees.

The rates for all dormitory suites are $81 a year for each occupant. Single rooms are $65 a year. Applications should be addressed to the Bursar.

DROWN MEMORIAL HALL

Drown Memorial Hall, erected by his friends and the alumni of the University as a memorial to the late Thomas Messinger Drown, LL.D., President of the University from 1895 to 1904, is devoted to the social interests of the University students. It contains study, reading, conversation, and chess rooms, an assembly hall, and the offices of the Alumni Association, the Young Men's Christian Association, the College Publications, the Dramatic and Musical Organizations. It also accommodates the Supply Bureau, conducted by the University, the purpose of which is to furnish books, stationery and supplies to the students at reasonable prices. The profits of the Supply Bureau are applied to the upkeep of Drown Memorial Hall.

THE COLLEGE COMMONS

The Commons was erected in 1907 to furnish a place where students might obtain wholesome food at cost. There are accommodations for four hundred students. The rates for table board are $15 for thirty consecutive days, or $4 for a single week.

TAYLOR GYMNASIUM

In 1913 Charles L. Taylor, a graduate of the University of the Class of 1876 and a member of the Board of Trustees, donated to the University the funds required for the erection of a new gymnasium, with swimming pool, game room, hand ball court and all modern accessories; also a Field House, fitted with eighty steel

lockers and ten hot and cold water shower baths, furnishing accommodations for the various athletic teams.

Taylor Gymnasium is located at the extreme east end of the grounds of the University, adjoining the Athletic Field. The building is 222 feet long by 73 feet wide. On the ground floor at the north end is located the game-room, 93 by 70 feet, used for basketball and wrestling. The game-room is surrounded by an ample-sized gallery for spectators. The main gymnasium floor measures 90 by 70 feet. Other rooms in Taylor Gymnasium are the offices and measuring room of the Department of Physical Education, a large trophy room, basket-ball and handball courts, fencing, boxing and wrestling rooms, and locker rooms with accommodations for the entire student-body.

The Gymnasium is equipped with all modern appliances for recreative and corrective exercises, also with apparatus for calisthenic and other gymnastics, both for individual and for class work.

In addition to numerous hot and cold shower baths, adjoining the locker rooms, is a swimming pool, 75 by 25 feet, with a depth from 4½ to 9½ feet. The capacity of the swimming pool is 95,000 gallons.

TAYLOR FIELD

An athletic field of over nine acres in area is provided by the University for the accommodation of students who wish to participate in the various outdoor sports. The stadium is located on the north side, or lower level, and provides football and baseball fields, the football field being used for soccer in the winter and lacrosse in the spring. It will ultimately be surrounded by concrete stands of which the south and west sides have been erected. The present stands and bleachers furnish a seating capacity for over 10,000 spectators. On the upper level are provided practice fields for football, baseball, and lacrosse, also a quarter mile track and a 220-yard straightaway, furnishing ample room for exercise by the entire student-body. During the winter months a wooden outdoor running track, twelve laps to the mile, is provided.

A Cage with 60 by 120 feet floor space is provided for indoor baseball, lacrosse, and track and field sports practice.

All athletic sports are under the direction and oversight of the Professor of Physical Education, who is aided by an Athletic Committee composed of Alumni and students, members of the Faculty, a member of the Board of Trustees, and the President of the University.

SAYRE PARK

This development of the mountain side of the University grounds was effected through the donation to the University in 1909 of the sum of $100,000 by the children of the late Robert H. Sayre to be applied and used in the development of Sayre Park as a memorial to their father. Mr. Sayre was a Trustee of the University from its foundation in 1866 to his death in 1907. He acted for years as the Chairman of the Executive Committee of the Board of Trustees, and his services to Lehigh were constant and great. It is a matter of great satisfaction to the Alumni of the University that his name should be enshrined in this beautiful park on South Mountain.

THE ARBORETUM

The Arboretum, a tract of about eleven acres added in 1909 to the upper end of Sayre Park, was established by a lover of Forestry and a friend of the University as a tree nursery for the purpose of furnishing illustrative specimens of our American trees, and of cultivating trees and shrubs for the beautifying of the Park. All of the more important species of North American trees are to be found in the University Park and the Arboretum. Adjoining the Arboretum a tract of seven acres has been planted with a variety of indigenous trees as an exhibition growth of tree culture.

DIPLOMAS AND CERTIFICATES

The Diploma is given only to those who have passed all the examinations of the regular course. For all the partial courses a certificate is given, signed by the Secretary of the Faculty, and showing what the student has accomplished.

THE UNIVERSITY MUSEUMS

The University Museums include large collections illustrating various branches of Chemistry, Metallurgy, Geology, Mineralogy, Zoölogy and Archæology.

The Metallurgical Cabinet includes specimens illustrating the various processes for obtaining the more common metals.

The Zoölogical collections include the Packer collection of recent shells and the Werner collection of American birds. The latter contains over three hundred and fifty species. In most cases, in addition to the adults, specimens in different plumages as well as the nests and eggs are represented.

The Geological and Mineralogical Museums are located in the west end of Williams Hall, and contain the Roepper and Keim mineral collections, collections of fossils, specimens of ore from mining districts, and extensive series of rocks which illustrate the type occurrences in different parts of the world.

The Cummings Archæological Cabinet has three thousand specimens and includes Dr. Stubb's collection of Indian relics, weapons, and utensils.

UNIVERSITY LECTURES

From time to time during the University year, distinguished men are invited to lecture before the students upon those special subjects to which they have given particular attention and upon which they are authorities.

The following lectures have been given in this course during the years 1913-1914 and 1914-1915:

Mr. Clayton S. Cooper, "The Coming Men of the Orient."

Dr. J. T. Rothrock, "The Place of Forests in National Life."

Mr. H. W. Du Bois, "Hunting with a Camera in Alaska."

Dr. C. J. Hunt, "Typhoid Fever and Preventive Medicine."

Mr. Arthur Frederick Sheldon, "The Philosophy of Success."

Mr. Ernest Harold Baynes, "Wild Birds and How to Attract Them."

Mr. J. Horace McFarland, "Wanted—American City Planning for American Cities."

Mr. George T. Fonda, "General Methods of Safety and Welfare Work."

Mr. S. B. Elliott, "Our Forest Conditions and Needs."

Mr. Edward A. Woods, "Thrift."

Dr. A. S. Cooley, "Treasures of Antiquity on French Soil."

Rt. Rev. Ethelbert Talbot, "Pioneer Life in the Rockies."

Prof. W. S. Franklin, "The Yellowstone Park."

Major General Leonard Wood, "Military Preparedness."

Mr. Charles Enzian, "Anthracite Coal Mining."

Hon. W. D. B. Ainey, "An Awakened Orient."

Dr. Edward Breck, "Our Navy and What it Means."

Mr. C. F. Roland, "The Manufacture of Steel."

THE CHEMICAL SOCIETY

The Chemical Society was organized in the fall of 1871.

The collections of botanical and zoölogical specimens belonging to the Society are important. During past years persons have

been sent to Texas and Brazil to collect specimens for these cabinets.

THE ENGINEERING SOCIETIES

The original Engineering Society was organized in 1873 and was open to all technical students of the University. From 1885 to 1890 it issued quarterly five volumes of "The Journal of the Engineering Society of Lehigh University," containing contributions by the members, alumni, and others. Many of the papers read before this Society from 1890 to 1893 were published in "The Lehigh Quarterly."

In 1900 the Civil Engineering and Mechanical Engineering students formed independent societies. The Electrical Engineering Society, founded in 1887, was reorganized in 1901. Later the Metallurgical Society and the Mining and Geological Society were formed. All these Societies hold monthly meetings for the reading and discussion of papers relating to the subjects of their particular departments.

THE ARTS AND SCIENCE CLUB

The Arts and Science Club was organized in the fall of 1905. Its object is to supplement the routine class-room work of the course in Arts and Science by the reading and discussion of papers on topics of varied interest. Discussions are led from time to time by members of the Faculty and addresses are made by scholars from outside the University. Students in all the courses of the University are eligible for membership.

THE CHINESE CLUB OF LEHIGH UNIVERSITY

The Chinese Club was organized in November, 1909, by the Chinese students of the University for literary purposes and the mutual profit of its members.

THE Y. M. C. A. OF THE UNIVERSITY

The Christian Association is a voluntary organization of the students for the promotion of the religious, moral, and social life of the University. It was organized April 18, 1890, and on October 11, 1890, united itself with the Intercollegiate Young Men's Christian Association. The movement is distinctly for and by students, all the officers, with the exception of the General Secretary, being chosen from the student-body.

FOUNDER'S DAY

On the first Saturday of October of each year, Commemorative Exercises are held in honor of the Founder of the University. On Saturday, October 2, 1915, the thirty-sixth Founder's Day was celebrated. The oration of the day was delivered by the Hon. Frank M. Trexler, Judge of the Superior Court of Pennsylvania.

PUBLIC WORSHIP

Morning Prayers are held in the Packer Memorial Church of the University, at which attendance is required.

UNIVERSITY SERMON

The University sermon is preached on the Sunday before University Day. The Rev. Floyd W. Tomkins, Rector of the Church of the Holy Trinity, Philadelphia, Pa., was the preacher on Sunday, June 6, 1915, in the Packer Memorial Church.

HONOR SYSTEM

The Honor System is in force at Lehigh University, having been adopted by the unanimous action of the student-body.

GRADUATING THESES

Every student is required to present a thesis upon some topic connected with the course from which he is to graduate, as a necessary portion of the exercises for his final examination for a degree. These theses are accompanied by drawings and diagrams, whenever the subjects need such illustration. The originals are kept by the University, as a part of the student's record, for future reference, but a copy may be retained by the student, and be published, permission being first obtained from the Faculty.

Theses on the following subjects were prepared by candidates for degrees in 1915.

MASTER OF ARTS

JOHN AMOS COMENIUS MUELLER, A.B., (*Moravian College*), Watertown, Wis.

STANLEY JUDSON THOMAS, B.S., (*Lafayette College*); M.S., (*Lehigh University*), Bethlehem.

A Study of Stereo-Isomerism in Fermentation Lactic Acid.

MASTER OF SCIENCE

SIEGFRIED FISCHER, B.S., (*Columbia University*), South Bethlehem.
Vapor Tension of Metals Below Their Melting Points.

HOWARD MASSEY FRY, E.E., (*Lehigh University*), Bethlehem.
Tests of Ulbricht Sphere and Matthews Integrating Photometer.

JAMES SCOTT LONG, Ch.E., (*Lehigh University*), York.
Improvements in the Technology of Linseed Oil.

SAMUEL HENRY SALISBURY, JR., B.S. (in Chem.),
(*Lehigh University*), South Bethlehem.
Increase of Yield in the Manufacture of Formic Acid.

MILTON MAURICE SHAW, M.E.,
(*Lehigh University*), Washington, D. C.
The Utilization of Low-Grade Anthracite for the Generation of Power.

BACHELOR OF ARTS

GEORGE SYDNEY PARLOUR, Allentown.
Democracy, Ancient and Modern.

SAMUEL PAUL TAYLOR, Altoona.
Some Phases of the Embryology of the Chick.

CLARENCE REINOEHL WAGNER, Lebanon.
Marriage and Divorce.

CHARLES ABRAHAM WOLFE, Allentown.
German Corporation Law.

BACHELOR OF SCIENCE

FRANK RODERICK ABBOTT, New York, N. Y.
The Political Significance of Economic Geology.

GEORGE WILLIAM HOBAN, Claremont, N. H.
The Psychology of Advertising.

LLOYD HOFFMAN, Pottersville, N. J.
Gold Placers, their Occurrence and Examination.

LLOYD EDWARD KEYES, Saratoga Springs, N. Y.
Conflict of Laws.

WILLIAM CONRAD MAYER, Brooklyn, N. Y.
A History of the Calendar with the Theory and Methods Used in Calendar Computations.

WILLIAM STAUFFER MORE, Bethlehem.
Viscosity of Oils.

RAYMOND ARTHUR RANK, Palmyra.
The Brownstones of Pennsylvania.

FREDERIC DONALD SCHREIBER, Ocala, Fla.
The Separation of Titanium Phosphate Ores of Virginia.

HAROLD GOODMAN SHOEMAKER, Bridgeton, N. J.
The Interstate Commerce Commission.

CARL EDWARD SIEBECKER, Scranton.
Paper Money.

CIVIL ENGINEER

ALBERT JUSTIN AMBROSE, Springfield, Mass.
A Study of Failures of Steel Bridges.

LEROY ROBERTS ATKINS, Lebanon.
A Study of the Engineering Features of the Panama Canal.

DAVID LAMBERTON BAIRD, Beverly, N. J.
Determination of Stresses in the Eighth Street Viaduct, Allentown, Pa.

JOSIAH PERKINS BALLINGER, Elizabeth, N. J.
The Theory of Domes.

JOHN EDMISTON BAUMAN, A.B. (*Muhlenberg College*), Allentown.
Failure of Masonry Dams.

ALBERT STEIN BLANK, Allentown.
Study of Flood Control Methods.

CLIFTON LINFORD BUTLER, Beach Haven, N. J.
History of Pennsylvania's Canals.

DANIEL RUSSELL CAHILL, South Bethlehem.
The Theory of the Design of Retaining Walls.

ALEXANDER SAMUEL DIVEN, 3RD, Elmira, N. Y.
The Study of Various Methods of Constructing Roads.

OTTO ERNEST HAGER, Wilkes-Barre.
Accuracy of Present Methods of Concrete Arch Design.

JULIUS FREDERICK HARDER, Newark, N. J.
Elimination of Grade Crossing at Coopersburg, Pa.

JOHN BOSLEY HISS, Baltimore, Md.
The Use of Concrete in Railroad Construction.

WILLIAM HAYES KELCHNER, New York, N. Y.
A Study of the Signal System of the Northern Central Division of the Pennsylvania Railroad.

WILLIAM SETH KIRBY, Oxford, Md.
Tunneling.

HECTOR LOPEZ, Granada, Nicaragua.
Design for a Reinformed Concrete Beam Bridge.

DAVID MCKELVY PETERSON, Honesdale.
Design for a Reinforced Concrete Coal Pocket.

RUSSELL MASON PIERSON, Morristown, N. J.
A Study of Shore Protection.

THOMAS JAMES PRIESTLEY (with C. R. Streets), Chicopee, Mass.
Electrolysis of Steel in Concrete.

ISAAC WILLIAM PUGH, Oxford.
A Study of the Linden (New York) Reservoir.

HENDRICK MONROE SEARCH, Philadelphia.
Hydroelectric Development of the Lehigh River between Mauch Chunk and White Haven.

WILLIAM AUGUSTUS STICKEL (with P. M. Teeple), Newark, N. J.
Tests to Determine the Effect of Density on the Strength of Concrete Columns.

CARLL REES STREETS, B.A., (*Lehigh University*), (with T. J. Priestley), Bridgeton, N. J.
Electrolysis of Steel in Concrete.

CHARLES WARNER TANNER, Peckville.
Design for a Concrete Bridge at South Allentown, Pa.

PERRY MCKEE TEEPLE (with W. A. Stickel), Glyndon, Md.
Tests to Determine the Effect of Density on the Strength of Concrete Columns.

CECIL RUSSELL UHL, Mount Savage, Md.
Determination of Physical Properties of Sand for American Society for Testing Materials.

SALVADOR VIVO, M.E. (*Cornell University*), Lares, Porto Rico.
Loss of Head in a Four-Inch Wrought Iron Water Pipe Due to Curvature.

EDWARD HIGGINSON WILLIAMS, 3RD, A.B., (*Williams College*), Woodstock, Vt.
The Electrification of Railroads.

RICHARD FRANCIS WOOD, Philadelphia.
A Design for a Reinforced Concrete Hollow Dam.

STANLEY ALBERT WUCHTER, Allentown.
Effect of Hydrated Lime on Portland Cement Mortars.

MECHANICAL ENGINEER

DAVID CARLYLE AINEY, Montrose.
Gyroscopic Action: Its Detrimental Effects and Suggestions for Its Absorption for Purposes of Transportation.

ALFRED VANSANT BODINE, Lambertville, N. J.
Complete Power Plant Test of Lambertville Heat, Light & Power Company, with View to Decreasing Operating Costs.

HAROLD AUGUSTUS BROWN (with D. Davidson), Carbondale.
Use of Flowing Water in Producing a Vacuum.

GARLAND CARPENTER CHEWNING (with H. R. Smith), Richmond, Va.
Tests of Automobile Gas Engines.

DELOZIER DAVIDSON (with H. A. Brown), Elizabeth, N. J.
Use of Flowing Water in Producing a Vacuum.

PHILIP GREENAWALT DEHUFF (with J. R. Dilley), Lebanon.
Maximum Economic Efficiencies in Steam Power Plants.

HARRY JAMES DILCHER, Allentown.
Comparison Tests to Show the Difference in Operating Costs between Condensing and Non-Condensing Operation on Municipal Pumping Station, Catasauqua, Pa.

JESSE RICHARD DILLEY (with P. G. DeHuff), South Bethlehem.
Maximum Economic Efficiencies in Steam Power Plants.

LINWOOD HIRSCH GEYER (with W. B. Neide), New York, N. Y.
Comparative Fuel Tests on the Boiler Plant of the Rittersville, Pa., Hospital.

ALBERT FREDERICK GLASS, Milwaukee, Wis.
A Gearless and Magnetic Transmission for Automobiles.

EFFINGHAM PEROT HUMPHREY, Wilkes-Barre.
Design of a 2500-Ton Coal Breaker.

JAMES HARPER MCKEE (with J. C. Miller), Catasauqua.
Gas Engine Design with Special Attention Paid to New Invention on Valve Mechanism.

JAY C. MILLER (with J. H. McKee), Bangor.
Gas Engine Design with Special Attention Paid to New Invention on Valve Mechanism.

WILSON BUTLER NEIDE (with L. H. Geyer), Philadelphia.
Comparative Fuel Tests on the Boiler Plant of the Rittersville, Pa., Hospital.

JOHN EDWARD NICHOLAS, Eckley.
Design of a Gas Engine.

HARRY RUSSEL SMITH (with G. C. Chewning), Shenandoah.
Tests of Automobile Gas Engines.

METALLURGICAL ENGINEER

ARENT HENRY SCHUYLER, New York, N. Y.
Heat Losses from an Electric Steel Furnace.

ELECTROMETALLURGIST

THOMAS WATSON DOWNS, Steelton.
Study of an Electric Steel-Casting Furnace.

KENNETH HASSLER READ, Washington, D. C.
The Latest Heat of Fusion of Commercial Zinc-Aluminium Alloy.

WILLIAM HARMAN WILLS, JR., Wilkinsburg.
Heat Losses from an Electric Steel Furnace.

ENGINEER OF MINES

LEONARD JEROME BUCK, (with A. J. Wiegand), Bethlehem.
Availability of Limestone in the Allentown Quadrangle for Fluxing Purposes.

LUEN YUEN CHOW, Ningpo, Chekiang, China.
Concentration Tests on a Gold Copper Ore.

STEPHEN HOWARD JOSEPH DALEY, Hartford, Conn.
Proposed Gardner Tunnel for Drainage, Transportation and Development.

DOUGLAS MACDONALD DUNBAR, Valley Cottage, N. Y.
The Location and Estimate of Cost of a Railroad Line.

CHARLES WELLMAN FRANCIS, Steelton.
The Iron Ores near Santiago de Cuba, and their Practical Application in the Blast Furnace.

ROBERT EDWARD GOYNE, Ashland.
Report on Construction of Ash Wash-Disposal Plants at Anthracite Collieries.

SAN-ZEN KAUNG, Kiating, Kiang-Soo, China.
Design of an Aerial Tramway.

SAMUEL WILSON LAIRD, Williamsport.
The Opening of an Anthracite Mine in Schuylkill County, Pa.

JOSEPH WILLAN RAINE, Evenwood, W. Va.
The Opening and Development of the Property of the Conemaugh Smokeless Coal Co., Indiana County, Pa.

ROBERT PEIRCE SANBORN, Germantown.
Application of Storage Batteries to Mine Locomotive Haulage.

CARLETON SCHWAB WAGNER, Philadelphia.
Increased Possibilities of Ore Deposit due to Greater Facilities of Transportation.

AUGUST JOHN WIEGAND (with L. J. Buck), Philadelphia.
Advisability of Limestone in the Allentown Quadrangle for Fluxing Purposes.

ELECTRICAL ENGINEER

FRANCIS COMENIUS BROCKMAN (with M. A. Weaver), Nazareth.
Experimental Study of High Frequency Oscillations.

OVID WALLACE ESHBACH (with H. L. Vitzthum), Pennsburg.
Methods of Determining the Magnetic Properties of Iron and Steel.

ELMER ROY FREY (with C. M. Sieger), Coplay.
An Investigation of the Reactance of Transformers.

NIEL FRANCIS MATHESON, Middletown.
The Commutation of Interpole Motors.

CHARLES MATTHEW SIEGER (with E. R. Frey), Coplay.
An Investigation of the Reactance of Transformers.

HARRY LOUIS VITZTHUM (with O. W. Eshbach), Baltimore, Md.
Methods of Determining the Magnetic Properties of Iron and Steel.

MYRON ALEXANDER WEAVER (with F. C. Brockman), Center Valley.
Experimental Study of High Frequency Oscillations.

ROBERT CADWALADER WICKERSHAM, Steelton.
Study of Methods of Power Factor Correction.

BACHELOR OF SCIENCE IN CHEMISTRY

JOSEPH WAGNER ALBRECHT, South Bethlehem.
Relations between the Heat Values, Ash and Fusibility of Ash in Bethlehem Steel Company Coals.

CHEMICAL ENGINEER

RICHARD NOBLE BOYD, Scranton.
Nitration Products of Animal Waxes.

ALBERT HOLTON FREY, Baltimore, Md.
The Hydrogenation of Some Oils and Fats.

LOUIS GEORGE GLESMANN, Rome, N. Y.
A Sudy of Recoveries in Certain Tin-Copper Scrap.

CLARENCE JEROME LENTZ, Allentown.
A New Method for the Rapid Determination of Iodine in Iodides.

WILLIAM EVAN LEWIS, A.B. (*Haverford College*), Allentown.
A Bacterial and Chemical Survey of the Lehigh County Poor-Farm Sewage Disposal Plant.

CHIN WONG, Chekiang, China.
Solubilities in the System, Calcium, Ammonium, Oxalic Acid.

UNIVERSITY DAY

This day is the last of the academic year, and falls in 1916 on the second Tuesday in June. On this day orations are delivered by members of the graduating class, and degrees are conferred.

EXERCISES ON JUNE 8, 1915

MUSIC

PRAYER

MUSIC

ALUMNI ADDRESS,

EDWARD H. WILLIAMS, JR., A.B., B.S., '75, E.M., '76, Sc.D., LL.D., '13.

PRIZES AWARDED, 1915

The Wilbur Scholarship of $200 to
DAVID REUBEN BROBST, of Freeland.

First in rank in the Sophomore Class, with honorable mention of
GASTON MILTON LEVY, of Norfolk, Va.

The John B. Carson Prize, for the best thesis in the Civil Engineering Department, to
ISAAC WILLIAM PUGH, of Oxford.

The Alumni Prizes of $25, for first honor men in the Junior Class in various departments, were awarded to
CHARLES ELMER PAULES, of Marietta,
in the Department of Civil Engineering, and
JOSEPH ANTHONY WYLER, of Scranton,
in the Department of Chemistry and Chemical Engineering.

The Price Prize of $25 for English Composition, open to members of the Freshman Class, was awarded to
WILLIAM GREGORY BARTHOLD, of Bethlehem.

The Williams Prizes of $10 and $5 for Excellence in English Composition, open to members of the Sophomore Class, were awarded to
DAVID REUBEN BROBST, of Freeland.
JOSEPH EDWIN FROBISHER, JR., of Arlington, N. J.
MILES BERTRAM MESSINGER, of Bethlehem.
GEORGE DOUGLAS HENDERSON, of Dunellen, N. J.
GILBERT CUNKLE HOWARD, of Harrisburg.

The Wilbur Prizes of $10 for excellence in the studies of the Sophorore year were awarded as follows:

In Mathematics, to

GASTON MILTON LEVY, of Norfolk, Va.

In English, to

MILES BERTRAM MESSINGER, of Bethlehem.

In Physics, to

JOSEPH EDWIN FROBISHER, JR., of Arlington, N. J.

The Wilbur Prizes of $15 and $10, for excellence in the studies of the Freshman year, were awarded as follows:

In Mathematics, to

WALTER RAYMOND PENMAN, of Hazleton.

JAY PHAON CLYMER, of Lebanon, and

FRANKLIN BAILY SPEAKMAN, of Strathmere, N. J., jointly.

In English, to

CHARLES FREDERICK RUFF, of Philadelphia.

In German, to

HENRY NILS ROEST, of Bethlehem.

In French, to

JOHN JOSEPH EARLY, of Campello, Mass.

HONOR LIST

SENIOR HONORS

Civil Engineering Course.

First: PERRY MCKEE TEEPLE, of Baltimore, Md.

Second: CECIL RUSSELL UHL, of Mount Savage, Md.

Mechanical Engineering Course.

First: JESSE RICHARD DILLEY, of South Bethlehem.

Second: HARRY JAMES DILCHER, of Allentown.

Metallurgical Engineering and Electrometallurgy Courses.

First: WILLIAM HARMAN WILLS, JR., of Wilkinsburg.

Electrical Engineering Course.

First: OVID WALLACE ESHBACH, of Pennsburg.

Second: HARRY LOUIS VITZTHUM, of Baltimore, Md.

Chemistry and Chemical Engineering Courses.

First: CLARENCE JEROME LENTZ, of Allentown.

JUNIOR HONORS

Civil Engineering Course.

First: CHARLES ELMER PAULES, of Marietta.

Second: WILLIAM ANTHONY CANNON, of Allentown.

Mechanical Engineering Course.
First: Robert Clinton Uhl, of Mount Savage, Md.
Second: William Dewey Reese, of Rome, N. Y.

Electrical Engineering Course.
First: Asher Freeman Hess, of Quakertown.
Second: Robert William Wieseman, of Harrisburg.

Chemistry and Chemical Engineering Courses.
First: Joseph Anthony Wyler, of Scranton.

SOPHOMORE HONORS

In Mathematics.
First: David Reuben Brobst, of Freeland.
Second: Gaston Milton Levy, of Norfolk, Va.
Third: Chester Ward Kingsley, of South Bethlehem.

In English:
First: Miles Bertram Messinger, of Bethlehem.
Second: George Douglas Henderson, of Dunellen, N. J.

In Physics.
First: Joseph Edwin Frobisher, jr., of Arlington, N. J.
Second: Frank Oscar Anderson, of Baltimore, Md.

FRESHMAN HONORS

In Mathematics.
First: Walter Raymond Penman, of Hazleton.
Second: Jay Phaon Clymer, of Lebanon, and
Franklin Baily Speakman, of Strathmere, N. J., jointly.

In English.
Charles Frederick Ruff, of Harrisburg.

In German.
Henry Nils Roest, of Bethlehem.

In French.
John Joseph Early, of Campello, Mass.

Degrees in course were then conferred by the President of the University upon the candidates whose names appear in the Thesis List, as given above.

THE WILBUR SCHOLARSHIP

This scholarship was founded in 1872 by the late E. P. Wilbur, Esq., of South Bethlehem, and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

THE HARRY S. HAINES MEMORIAL SCHOLARSHIP

Mrs. Henry S. Haines, of Savannah, Ga., established in 1889 a scholarship of the annual value of $200 as a memorial of her son, Henry Stevens Haines, M.E., a member of the Class of 1887. This scholarship is devoted to the support at Lehigh University, throughout his scholastic career, of one student in the School of Mechanical Engineering.

THE FRED. MERCUR MEMORIAL FUND SCHOLARSHIPS

Friends of the late Frederick Mercur, of Wilkes-Barre, Pa., General Manager of the Lehigh Valley Coal Company, desiring to establish a memorial of their friendship and esteem, and to perpetuate his memory, contributed and placed in the hands of the Trustees a fund called "The Fred. Mercur Memorial Fund," sufficient in amount to insure the award of three scholarships for free tuition in the University.

THE ECKLEY B. COXE MEMORIAL FUND

In memory of the late Hon. Eckley B. Coxe, Trustee of the University, Mrs. Coxe has established a fund, amounting to $30,000, the interest of which is used, under the direction of the Trustees of the University, and subject to such regulations as they may adopt, for the assistance of worthy and needy students requiring financial aid.

THE FRANK WILLIAMS FUND

Frank Williams, E.M., of Johnstown, Pa., a graduate of the course in Mining and Metallurgy of the Class of '87, who died October, 1900, bequeathed to the University the greater part of his estate, now amounting to over $120,000, to found a Fund, the income of which is lent to deserving students. At present the larger part of this income is devoted to certain life tenants under Mr. Williams' will. After their death the entire income will be awarded as above.

WILBUR PRIZES

A fund was established, yielding an annual income of $100, by the late E. P. Wilbur, Esq., for distribution in prizes as the Faculty shall determine.

THE PRICE PRIZE FOR ENGLISH COMPOSITION

Dr. Henry R. Price, an Alumnus and Trustee of the University, established in 1898 an annual prize of the value of $25, to be awarded in June to that member of the Freshman Class who shall write the best essay on a topic in English Literature assigned by the head of the department of English not later than the beginning of the second term in each year.

In estimating the value of all such essays the greatest stress will be laid upon clearness of thought and idiomatic force of expression; and, in the judgment of the examiner, while looking for correctness of thought in clear and forcible English, expression will take precedence of matter. For this specific end, weight will be given to the form rather than to the matter presented.

Competitors must signify their intention in writing not later than the first of April.

The subject for the prize essay in June, 1916, will be: The Literary Aspect of the Massachusetts Colony between 1620 and 1676.

THE JOHN B. CARSON PRIZE

This prize of $50 annually was established in 1909 by Mrs. Helen C. Turner, of Philadelphia, Pa., in memory of her father, John B. Carson, whose son, James D. Carson, was a graduate of the Civil Engineering Department of Lehigh University in 1876. It is awarded for the best thesis in the Civil Engineering Department.

ALUMNI PRIZES

By a resolution of the Alumni Association of September 21, 1900, the Alumni Scholarship Fund, which was originally designed to help poor students, was with the consent of the contributors diverted from this purpose and the income devoted to prizes to members of the Junior Class. In June, 1916, two prizes of $25 each will be awarded to the first honor men of the course in Mechanical Engineering and of the group comprising the Junior Students in Metallurgical Engineering, Electrometallurgy, and Mining Engineering. In subsequent years the prizes will be awarded to the first honor men of the other technical courses in turn.

ALUMNI PRIZES FOR ORATORY

The Alumni Association of Lehigh University established in 1882 an annual sum of $50, to be distributed in prizes for excellence in Oratory, subject to the following:

REGULATIONS

1. The contest shall be held on the 22d day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of $25, a second prize of $15, and a third of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the orations shall be announced at the beginning of the first term of every year, and upon one of these each competitor shall write an oration not to exceed 1200 words, taking about eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do—should they be sufficient in number—the best six shall be chosen, and their envelopes opened. The others shall be returned to the addresses given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors whose orations shall have been approved, and the awards shall be made by a majority of these judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

The annual contest in Oratory for the Alumni Prizes was held on February 22, 1915, with the following competitors:

Ellis Brodstein, of Reading.

Charles Henry Cope, of Bethlehem.

Harold Irvine Fair, of Brooklyn, N. Y.

Joseph Anthony Wyler, of Scranton.

Donald Thomas Wynne, of New Haven, Conn.

The First Prize was awarded to D. T. Wynne; the Second to C. H. Cope, and the Third to H. I. Fair.

The Judges were the Very Rev. Frederick W. Beekman, Rector of the Church of the Nativity, South Bethlehem, Pa.; Vincent B.

Brecht, Head of the Department of English, Northeast High School, Philadelphia, Pa.; and Clarence W. Hudson, '89, Professor of Civil Engineering, Brooklyn Polytechnic Institute, Brooklyn, N. Y.

In connection with the celebration of Washington's Birthday, the Honorary Degree of Doctor of Laws was conferred on John Henry MacCracken, A.B., A.M., Ph.D., LL.D., President of Lafayette College.

WILLIAMS PRIZES IN ENGLISH

Prof. Edward H. Williams, jr., an alumnus of the University, a graduate of the Class of 1875, established in February, 1900, prizes amounting annually to three hundred and thirty-five dollars for excellence in English Composition and Oratory, to secure which he has placed an ample endowment in the hands of the Trustees of the University. The conditions of the endowment are as follows:

Sophomore Composition Prizes

1. At the beginning of each term the Sophomore Class shall be divided into two sections alphabetically and to that student in each section who, at the end of a term, and of each term, shall receive the highest rank in English Composition during that term shall be awarded the "First Sophomore Composition Prize" of ten dollars, and to that student in each section as aforesaid who shall receive the next highest rank in the same subject shall be awarded the "Second Sophomore Composition Prize" of five dollars. In each year there will be offered four first and four second prizes—a total of sixty dollars.

If more than one student shall receive the highest rank in any section, the amount of the two prizes shall be added together and the sum—fifteen dollars—shall be equally divided between them, and no second prize shall be offered to that section. If more than one student shall receive the next highest rank in any section when there is but one contestant for the first prize, the second prize shall be equally divided between the two having the second rank.

Senior Premiums

2. The Faculty shall publish within one month of the end of the University year a list of subjects for dissertations, selected from English Literature and Economics, entitled Subjects for Senior Premiums. To this list shall be appended a date near the first of January following—to be determined upon by the Faculty

—when the contest shall be declared closed and the dissertations shall become due.

From the above list any member of the Senior Class may select a subject and write thereon a dissertation, whose length shall be prescribed by the Faculty, and shall send the same anonymously, but marked for identification, as the Faculty may direct, to the Secretary of the Faculty before the date aforesaid.

The Faculty, or its committee, shall meet on the above date and at subsequent adjourned meetings, and, first, having determined upon a standard of excellence which each and all dissertations must reach in order to be admitted to the following competition, shall examine the dissertations submitted to them and admit those which reach the above standard. In case none are up to the standard, and are admitted, they shall declare the contest closed for that year, and no prizes shall be awarded.

If one or more dissertations are admitted as aforesaid, the Faculty, or its committee, shall arrange them in the order of their literary merit and soundness of their reasoning, and the six highest in this arrangement shall be retained and all others returned as directed by the writers, who shall remain unknown. The names of the successful writers shall be ascertained and they shall be required to recast their dissertations in the form of an oration, and to speak the same in public at such time during the Commencement Week as the Faculty shall determine.

The Faculty, or its committee, shall be the judges of excellence in the speaking, and shall award to that Senior student who shall speak his oration in the best manner, the Senior Gold Medal, of the value of one hundred dollars, or, at his option, one hundred dollars in gold. They shall award to the other five speakers the five Senior Premiums of ten dollars each.

Graduate Prize

3. At the end of the University year, during Commencement Week, the Faculty shall publish a second list of subjects for theses selected from English Literature, Economics, Mental and Moral Science, and similar subjects which require thought and application, and which must be of such a character that their mastery shall be accomplished only through considerable research and study.

From this list any member of the class just graduating; the Senior Class of the coming University year; a graduate of one year's standing whether in or out of residence, and a graduate of

any class who may be, during the coming year, in actual residence and taking post-graduate work in the University, may select a subject and write thereon a thesis of not less than five thousand words and send the same to the Secretary of the Faculty, anonymously, but marked for identification as the Faculty may designate, before the date, which the Faculty shall select within one month before the next Commencement, and which date must appear on the above list.

The Faculty, or its committee, shall meet on this date, and at adjourned meetings thereafter, and, having first established a standard of excellence, which must, first, be a high one, and second, shall require on the part of the competitor ability in the plan, development, argument, and conclusion of the work, as well as literary merit in its composition and presentation, shall admit to the following competition only those which fully attain to the above required standard.

If none of the theses submitted shall have attained to the standard aforesaid, the competition shall be declared closed and the prize shall not be awarded.

To the author of that thesis which shall have been admitted to the competition, and which shall have been declared of the highest excellence, the Graduate Prize of one hundred and twenty-five dollars shall be awarded and presented on Commencement Day with the other prizes and awards of that day.

The successful thesis shall be the property of the University, but the author shall be allowed to retain one copy. Publication of the thesis by the author will only be permitted by vote of the Faculty. Such publications must, however, be entitled Graduate Prize Thesis of the Lehigh University.

The winner of a prize shall not be allowed to compete again.

Prof. Williams has directed that the income derived from the endowment for the Williams Prizes shall be applied and used as follows:

1. All portions of said income remaining after the payment of all prizes awarded in any one year, shall be invested and added to the principal of said endowment.

2. If any prize shall, for any reason, be not awarded in any year, the sum thus unpaid shall be invested and added to the said principal.

3. If for any reason the amount of the income from said endowment shall fall below the total sum necessary to pay said

prizes, the amounts of the individual prizes shall be proportionally reduced till their sum shall be equal to three-fourths of the said reduced income, and this three-fourths shall be used to pay them; the remaining one-fourth is to be invested and added to the said principal.

4. This investment of residues, as above said, shall continue till the principal of said endowment shall be sufficiently large to furnish an income at two per cent. interest, which will be sufficient to pay all said prizes now established.

5. When said principal shall be large enough to furnish the necessary sum to defray the said prizes, as stated in No. 4, the surplus income remaining after paying all the prizes awarded during the year shall be used by the President of the University to encourage oratory, debate, or any other object decided upon by the Faculty.

THE FRAZIER AND RINGER MEMORIAL FUND

This is a fund for the medical and surgical care of needy students, established in memory of Benjamin West Frazier, A.M., Sc.D., formerly Professor of Mineralogy and Metallurgy, and Severin Ringer, U.J.D., formerly Professor of Modern Languages and Literatures and of History, each of whom faithfully served Lehigh University for one-third of a century. The Fund was started February 12, 1906, by the donation by Robert H. Sayre, Esq., of thirteen thousand dollars. It is the hope and expectation of the friends of the University that this fund may, by other donations, be increased in time to amount to a sum sufficient to insure free medical and surgical attendance to all students of the University requiring such aid.

STUDENTS

B.A.—Bachelor of Arts.
Biol.—B.S. in Biology.
B.S.—Bachelor of Science.
Bus.—Business Administration.
C.E.—Civil Engineering.
Ch.E.—Chemical Engineering.
Chem.—Chemistry.
E.E.—Electrical Engineering.
El.Met.—Electrometallurgy.
Geol.—B.S. in Geology.
Math.—B.S. in Mathematics & Physics.
E.M.—Mining Engineering.
M.E.—Mechanical Engineering.
Met.—Metallurgical Engineering.

The names in the following lists include all the students who have registered and attended recitations at the University for the current year.

GRADUATE STUDENTS

	For Degree	Residence
Bartlett, Ralph Lincoln, S.B., (*Massachusetts Institute of Technology*)	M.S.,	South Bethlehem.
Beck, George Carlton, A.C., (*Lehigh University*)	M.S.,	South Bethlehem.
Bowen, Ezra, IV, B.S., (*Lehigh University*)	M.S.,	South Bethlehem.
Buchner, George Jantzen, B.S., (*College of the City of New York*)	M.S.,	South Bethlehem.
Callen, Arthur Spencer, El.Met., (*Lehigh University*)	M.S.,	South Bethlehem.
Carpenter, Lawrence Everett, Ch.E., (*Lehigh University*)	M.S.,	Newburgh, N. Y.
De Baufre, William Lane, E.E., M.E., (*Lehigh University*)	M.S.,	Annapolis, Md.
Durrell, Henry Eugene Allston, A.B., (*St. Stephen's College*)	M.A.,	Mauch Chunk.
Fraim, Parke Benjamin, E.M., (*Lehigh University*)	M.S.,	South Bethlehem.
Gauss, Chester Arthur, E.E., (*Lehigh University*)	M.S.,	New York, N. Y.
Grissinger, Elwood Aristides, E.E., (*Lehigh University*)	M.S.,	Buffalo, N. Y.
Gruber, Howard Dietrich, E.E., (*Lehigh University*)	M.S.,	South Bethlehem.

	For Degree	Residence
Heck, Lewis, B.A., (*Lehigh University*)	M.A.,	Constantinople, Turkey.
Higgins, Edwin, E.M., (*Lehigh University*)	M.S.,	San Francisco, Cal.
Higgins, Emerson Corson, jr., B.S., (*Lehigh University*)	M.S.,	Bayonne, N. J.
Hunt, Charles Jack, M.D., (*University of Pennsylvania*)	M.S.,	Philadelphia.
Irwin, Joseph Stewart, B.S., (*University of Missouri*)	M.S.,	South Bethlehem.
Jacobosky, Gilbert Garfield, C.E., (*Lehigh University*)	M.S.,	Wilkes-Barre.
Jauncey, G. E. M., B.S., (*University of Adelaide*)	M.S.,	Bethlehem.
Johnston, Robert, B.A., B.D., (*Williams College*)	M.A.,	Bethlehem.
Lambert, William Allen, B.A., (*Lehigh University*)	M.A.,	Lebanon.
Lewis, William Evan, A.B., Ch.E., (*Haverford College, Lehigh University*)	M.A.,	Allentown.
MaGuire, Charles Henry, B.S., (*Clarkson School of Tech.*)	M.S.,	Bethlehem.
Pearson, Charles William, B.S., (*Brooklyn Polytechnic Institute*)	M.S.,	Bayonne, N. J.
Schealer, Samuel Raymond, E.E., (*Lehigh University*)	M.S.,	Bethlehem.
Schmich, George Raymond, B.S., (*Moravian College*)	M.A.,	Bethlehem.
Shafer, Bentley Sayre, B.A., (*Lehigh University*)	M.A.,	Bethlehem.
Sultzer, Morton, E.E., (*Lehigh University*)	M.S.,	New York, N. Y.
Talmage, S. B., B.S,, (*University of Utah*)	M.S,	Salt Lake City, Utah.
Tarshich, J., A.B., (*University of Cincinnati*)	M.A.,	Allentown.
Toohy, John Milton, B.A., (*Lehigh University*)	M.A.,	South Bethlehem.
Vicente, Manual Lucas, C.E., (*Lehigh University*)	M.S.,	Mayaguez, P. R.

	For Degree	Residence
Waltz, A. K., B.S., (*Pennsylvania College*)	M.S.	Bethlehem.
Ward, Arthur Thomas, El.Met., (*Lehigh University*)	M.S.,	Raucagua, Chile.

Boston, Henry Robert, B.S., (*College of City of New York*)	C.E.,	New York, N.Y.
Christ, Roy Harold, B.S., (*Moravian College*)	El.Met.,	Allentown.
Drinker, Philip H., B.S., (*Princeton University*)	Ch.E.,	South Bethlehem.
Lewis, Samuel, B.S., (*Pennsylvania Military College*)	Chem.,	Allentown.
Luckenbach, Leonard Jacob, B.S., (*Moravian College*)	Geol.,	Bethlehem.
Markle, Donald, Ph.B., (*Yale University*)	E.M.,	Hazleton.
More, William Stauffer, B.S., (*Lehigh University*)	M.E.,	Bethlehem.
Mueller, Theophil Herbert, A.B., B.D., M.A., (*Moravian College, Lehigh University*)	C.E.,	Bethlehem.
Munger, James Speer, B.S., (*Moravian College*)	Bus.,	Nazareth.
Rawle, Joseph Francis, B.A., (*St. Joseph's College*)	C.E.,	Philadelphia.
Rice, Owen Rondthaler, B.S., (*Moravian College*)	Ch.E.,	Bethlehem.
Robinson, Edward Moore, A.B., (*Harvard University*)	E.M.,	New York, N. Y.
Robinson, Thomas Hastings, A.B., (*Princeton University*)	Chem.,	Lawrenceville, N. J.
Stephenson, Francis Lewis, Ph.B., (*Yale University*)	E.M.	Pittsburgh.
Swallow, Gerald, B.S., (*Pennsylvania Military College*)	M.E.,	Norristown.

SPECIAL GRADUATE STUDENT

	Course	Residence
Miller, Jay C., M.E., (*Lehigh University*)	Bus.,	Catasauqua.

SENIOR CLASS

Class of 1916

	Course	Residence
Adams, George Bristow,	M.E.,	Aberdeen, Md.
Alexander, William Hamlet,	Biol.,	South Bethlehem.
Allen, Leslie,	C.E.,	Allentown.
Anderson, Charles Irving,	Chem.,	Gloucester, Mass.
Andrews, Marlin Olmsted,	E.E.,	Coudersport.
Baker, Russell Ingram,	Chem.,	Lewistown.
Baush, John Rainey,	El.Met.,	Somerset.
Bausman, John Myers,	M.E.,	Bausman.
Bergstresser, Harold Frederick,	E.E.,	Emaus.
Bradley, Herbert Earle,	E.E.,	West Haven, Conn.
Brewster, Donald Cameron,	Bus.,	Montclair, N. J.
Brodstein, Ellis,	B.A.,	Reading.
Burke, James Michael,	Geol.,	Wakefield, Mass.
Cannon, William Anthony,	C.E.,	Allentown.
Carlson, Harry Siegfried,	Bus.,	Montclair, N. J.
Carlson, Oscar Ludwig,	Chem.,	Montclair, N. J.
Castillo, Ricardo Elpidio,	E.M.,	Guantanamo, Cuba.
Clare, Edwin Archdall,	B.A.,	Elizabeth, N. J.
Clark, Edward James,	M.E.,	Catasauqua.
Clement, Edward Jesse,	C.E.,	Tokyo, Japan.
Collier, Robert Bell,	Bus.,	Paterson, N. J.
Cope, Charles Henry,	B.A.,	Bethlehem.
Cranston, Arthur G.,	E.E.,	Johnstown.
Diefenderfer, Robert Newhart,	Biol.,	Bethlehem.
Downs, John M.,	E.E.,	Wharton, N. J.
Eberhard, Arthur Charles,	C.E.,	Allentown.
Fair, Harold Irvine,	B.A.,	Brooklyn, N. Y.
Fisher, Joseph Anton, jr.,	B.A.,	Sayville, N. Y.
Fleming, Andrew Ellett,	E.M.,	Big Vein, Craneco, W. Va
Ganey, Paul Jerome,	C.E.,	South Bethlehem.
Garges, Eugene Willard,	C.E.,	Doylestown.
Green, Fred William, jr.,	M.E.,	Wilbraham, Mass.
Grumbach, Louis Edward,	C.E.,	Rockville, Conn.
Hartmann, William Christian,	M.E.,	Bethlehem.
Heisler, Stanley Earl,	E.E.,	Hellertown.
Hess, Asher Freeman,	E.E.,	Quakertown.
Hicks, Robert Holliday,	E.E.,	Govans, Md.
Hill, John Balmain,	E.M.,	Roland Park, Md.

Hiss, Charles Alger,	E.E.,	Baltimore, Md.
Horine, Frederic Laurent,	Chem.,	Columbia, S. C.
Hsu, Shen Chin,	Met.,	Songlin, Huchow, China.
Johnson, Guy Roche,	E.M.,	South Bethlehem.
Johnston, Everitt Sommerville,	Bus.,	Newburgh, N. Y.
Keiser, Hubert Deans,	C.E.,	Philadelphia.
Kirkhuff, Ellison Lawrence,	C.E.,	Wilkes-Barre.
Koch, Wilmer Horace,	Chem.,	South Bethlehem.
Kresge, Miles Whitney,	M.E.,	South Bethlehem.
Laedlein, Robert Auguste,	E.E.,	Williamsport.
Lambert, Kenneth Alfred,	E.M.,	Bethlehem.
Lancaster, Leicester Hodges,	M.E.,	Waterbury, Conn.
Lazarus, George Henry,	M.E.,	South Bethlehem.
Lerch, Robert Thomas,	B.A.,	Bath.
Leslie, Herbert,	M.E.,	São Paulo, Brazil.
Levin, Louis Maurice,	C.E.,	Trenton, N. J.
McHugh, George Austin,	M.E.,	Hazleton.
Mack, Prowell Stauffer,	E.E.,	Hummelstown.
Mardaga, Louis,	M.E.,	Baltimore, Md.
Martin, Stanley,	E.M.,	Kingston.
Matthews, James Bennett, jr.,	Ch.E.,	New Castle.
Mayers, Henry Horace,	Chem.,	Reading.
Meredith, Joseph Arthur,	B.A.,	Allentown.
Miller, William Barth,	C.E.,	Kent, O.
Murphy, Caleb Temple,	Bus.,	Charlestown, W. Va.
Owen, Mark Nelson,	B.A.,	Hazleton.
Paules, Charles Elmer,	C.E.,	Marietta.
Preston, Marshall Robinson,	Bus.,	York.
Reese, William Dewey,	M.E.,	Rome, N. Y.
Reisler, Evan Holmes,	C.E.,	Quakertown.
Reitz, Robert Albert,	E.E.,	Baltimore, Md.
Reitzel, Jacob Henry,	M.E.,	Newark, N. J.
Roberts, Curlis,	C.E.,	Haddonfield, N. J.
Roberts, Dudley Emerson,	E.M.,	Stamford, Conn.
Rodgers, Henry Procter,	M.E.,	Baltimore, Md.
Royall, Nelson McFaden,	Ch.E.,	Lynchburg, Va.
Ryder, Frederick William,	M.E.,	Wilkes-Barre.
Sanford, Harold Edmund,	E.M.,	Portland, Ore.
Sawtelle, George,	Chem.,	Cleveland, Okla.
Schmoll, Elmer Frederick,	C.E.,	Wilkes-Barre.
Schuttler, Carl Hugo,	M.E.,	Wheeling, W. Va.
Scruggs, Stuart Briscoe,	C.E.,	Dallas, Texas.

Shay, Frederick William,	C.E.,	Fall River, Mass.
Sheckells, Robert Weech,	C.E.,	Baltimore, Md.
Smith, George Arthur,	M.E.,	Maxatawny.
Snyder, Clarence Henry,	Ch.E.,	Pennsburg.
Snyder, John Abner,	M.E.,	Roanoke, Va.
Stem, Laury George,	Chem.,	Northampton.
Stoudt, Morris Eugene,	C.E.,	Bethlehem.
Strausburg, Moses Alfred,	B.A.,	Easton.
Stritzinger, Frederick G.,	Bus.,	Norristown.
Taylor, Aaron Russell,	M.E.,	Philadelphia.
Thomas, Clifford Holden,	M.E.,	Berkley, Md.
Thorp, Gerald,	Chem.,	East Orange, N. J.
Todd, David, jr.,	E.E.,	Williamsport.
Uhl, Robert Clinton,	M.E.,	Mount Savage, Md.
Vogel, Harold Francis,	E.E.,	South Bethlehem.
Volkhardt, Walter,	M.E.,	Chester.
Webb, Oscar Everett, jr.,	M.E.,	Sudbrook Park, Md.
Wells, John Morgan,	M.E.,	Pottstown.
White, Harold Edward,	E.M.,	Buffalo, N. Y.
Whiteman, Daniel Swab,	E.M.,	Philadelphia.
Wieseman, Robert William,	E.E.,	Harrisburg.
Williams, Earle Cornelius,	E.E.,	Slatington.
Wyler, Joseph Anthony,	Chem.,	Scranton.
Wynne, Donald Thomas,	B.A.,	New Haven, Conn.

JUNIOR CLASS

Class of 1917

	Course	Residence
Alling, Guy Ethan,	Ch.E.,	Philadelphia.
Ancona, Paul Jones,	M.E.,	Reading.
Anderson, Frank Oscar,	M.E.,	Baltimore, Md.
Appel, Howard Frederick,	Met.,	Everett.
Ayrault, John, jr.,	Bus.,	Tonawanda, N. Y.
Bach, Adolph, jr.,	C.E.,	Bayside, N. Y.
Barkley, William O'Neal,	C.E.,	Phoenixville.
Beck, Wilbur Ahlborn,	E.E.,	St. Nicholas.
Becker, Franklin Nelson,	E.M.,	Philadelphia.
Benscoter, Frank Leland,	M.E.,	Carbondale.
Berg, Walter Philip,	M.E.,	Pittsburgh.
Bishop, Gordon Knapp,	M.E.,	Baltimore, Md.
Borden, Granville Spaulding,	E.M.,	Tunkhannock.

Botero, Baltasar,	E.M.,	Sansón, Colombia.
Breen, Leonard John,	C.E.,	Paterson, N. J.
Brenton, Walter,	Ch.E.,	Wilkes-Barre.
Brobst, David Reuben,	E.E.,	Freeland.
Buell, Albert Leonard,	M.E.,	Hackettstown, N. J.
Butterworth, George Appleton,	C.E.,	Harrisburg.
Buxton, Edwin Franklin Abell,	B.A.,	Govans, Md.
Carlson, John Arthur,	Bus.,	Montclair, N. J.
Carmichael, Elwood Trout,	E.E.,	Elizabeth, N. J.
Carter, Wayne Hanley,	Chem.,	Phoenixville.
Chenoweth, Albert Wayne,	Bus.,	El Paso, Texas.
Clark, John Fulmer,	M.E.,	Reading.
Colby, Richard Lee,	E.M.,	South Bethlehem.
Conrad, Loyal Richard,	B.A.,	Bayonne, N. J.
Cook, Robert Geiger,	C.E.,	Hammonton, N. J.
Crichton, Kyle Samuel,	B.A.,	Bethlehem.
Custer, Granville Yocum,	M.E.,	Douglassville.
Dayton, Harry Craven,	Ch.E.,	Port Jefferson, N. Y.
Derr, Brant Smith,	C.E.,	Baltimore, Md.
Dosch, Doron,	M.E.,	Elizabeth, N. J.
Doushkess, Victor Hugo,	Math.,	New York, N. Y.
Dynan, Alan Edmond,	E.M.,	Bethlehem.
Edwards, Stanley Townsend,	M.E.,	Olyphant.
Etter, John Luther,	C.E.,	Baltimore, Md.
Fehnel, James William,	Chem.,	Bethlehem.
Fishburn, Samuel,	Bus.,	Jamaica Plain, Mass.
Flinn, Elmer Harold,	El.Met.,	Philadelphia.
Forstall, Theobald,	Bus.,	Montclair, N. J.
Frobisher, Joseph Edwin, jr.,	M.E.,	Arlington, N. J.
Garrett, Curtis Lee,	E.E.,	Baltimore, Md.
Gilmore, Walter William,	B.A.,	Williamsport.
Greenawald, Edwin Jacob,	C.E.,	Allentown.
Greer, Robert Tyson,	E.E.,	Baltimore, Md.
Grossart, Lewis Phaon.	C.E.,	Allentown.
Hagenbuch, Jacob,	B.A.,	Bethlehem.
Hagey, Theodore Knauss,	E.E.,	Hellertown.
Hagglund, Lorenzo Frederick,	B.A.,	Centerport, N. Y.
Haller, Carl A.,	Met.,	Johnstown.
Halpin, Carroll Timothy,	E.E.,	Philadelphia.
Hanway, Paul Scott Hallowell,	Bus.,	Philadelphia.
Hartman, William Montgomery,	B.A.,	Reading.
Henderson, Douglas,	M.E.,	Overbrook.

Henderson, George Douglas,	M.E.,	Jersey City, N. J.
Herr, Lauriston Benjamin, jr.,	E.M.,	Lancaster.
Hoagland, Samuel King,	B.A.,	Bayonne, N. J.
Hogan, Harold Olmstead,	E.E.,	Baltimore, Md.
Homewood, George Morgan,	M.E.,	Baltimore, Md.
Hoover, Alan Creighton,	M.E.,	Weatherly.
Howard Gilbert Cunkle,	C.E.,	Harrisburg.
Hummel, Edgar Carroll,	E.E.,	Hummelstown.
Hunter, Frank Milton,	Met.,	Oakmont.
Jacobson, Bernard Howard,	El.Met.,	Baltimore, Md.
Jenness, Eugene Leavitt,	M.E.,	Chicago, Ill.
Johnson, Harry Firmstone Whelen,	Ch.E.,	South Bethlehem.
Jones, Bruce Meixell,	M.E.,	Wilkes-Barre.
Judson, Walter Joseph,	C.E.,	Norfolk, Va.
Justice, Philip Syng,	E.M.,	Ardmore.
Kammerer, Austin Clement,	Bus.,	New York, N. Y.
Kantner, Howard Elmer,	M.E.,	Wilkes-Barre.
Keady, James Edward,	Bus.,	Wakefield, Mass.
Kehrer, George Clarence,	E.E.,	Doylestown.
King, Walter Cornelius,	Math.,	Bethlehem.
Kingsley, Chester Ward,	E.E.,	South Bethlehem.
Kinter, George Reinohl,	Ch.E.,	Harrisburg.
Kirkpatrick, Dixon Heckman,	Bus.,	Scranton.
Kittle, Percy Hamilton,	E.M.,	Brooklyn, N. Y.
Knoss, Albert Frederick,	Chem.,	Phoenixville.
Kramer, Lewis Bieber,	El.Met.,	Robesonia.
Lacombe, Luiz Lourenco,	E.E.,	Philadelphia.
Langenheim, Albert Herbert,	M.E.,	Allentown.
Lee, John Rose,	Bus.,	Buffalo, N. Y.
Lehr, Harold Diefenderfer,	El.Met.,	Bethlehem.
Lemmon, James Russell,	M.E.,	Latrobe.
Leoser, Thomas Smith,	E.E.,	Morristown, N. J.
Levy, Gaston Milton,	M.E.,	Norfolk, Va.
MacIsaac, Donald,	M.E.,	Richmond Hill, N. Y.
McCann, Raymond Leon,	E.M.,	Harrisburg.
McDowell, Hamilton Erwin,	E.E.,	Asheville, N. C.
McGovern, James Joseph,	M.E.,	Lebanon.
McKinley, George,	B.A.,	Olyphant.
Magee, Frank Lynn,	E.E.,	South Bethlehem.
Merwarth, Harold Russell,	B.A.,	Easton.
Meschter, Homer Funk,	Chem.,	East Greenville.

Messinger, Miles Bertram,	B.A.,	Bethlehem.
Minnich, James Earl,	C.E.,	Robesonia.
Morrison, John Alexander,	E.E.,	Mount Airy.
Morrison, Joseph William,	M.E.,	Auburn.
Moyer, Charles Elwood,	C.E.,	Bethlehem.
Mudge, Louis Goldthwait,	Ch.E.,	Baltimore, Md.
Muñoz, Audato Lorenzo,	M.E.,	Santa Barbara, Honduras.
Neubert, Bedell Mordaunt,	C.E.,	New York, N. Y.
Nickum, William Franklin,	E.E.,	Allentown.
O'Brien, Leonard Guy,	B.A.,	Montrose.
Pardee, Howard Judd,	C.E.,	Cherry Valley, N. Y.
Pengelly, Thomas Stanley,	E.E.,	Hazleton.
Perkins, Hiram Ellsworth,	C.E.,	Sagamore, Mass.
Pike, Vernon Bender,	E.E.,	Cheltenham.
Pons, Nicholas Batista,	M.E.,	Niquero, Cuba.
Porter, Frederick Meredith,	B.A.,	York.
Portz, Fred Evans,	C.E.,	Arlington, N. J.
Powers, Frederic Davis,	Ch.E.,	Glen Ridge, N. J.
Ralph, Thomas Graham,	B.A.,	Crafton.
Randolph, John Hager,	M.E.,	Lynchburg, Va.
Rapoport, Julius Martin,	B.A.,	Allentown.
Rau, Earl Stanley,	E.E.,	Elkins Park.
Repa, Michael,	M.E.,	Wilkes-Barre.
Richards, William Allison,	E.M.,	Pottsville.
Ridgway, Reuben Lee,	C.E.,	Atlantic City, N. J.
Rosenstein, Arnold Stift,	M.E.,	Warsaw, Russia.
Ross, Ira George, jr.,	Bus.,	Mauch Chunk.
Ryon, Lewis Babcock, jr.,	C.E.,	South Bethlehem.
Savadkin, Solomon S.,	C.E.,	Scranton.
Schmidt, Frederick Lothar,	E.M.,	Brooklyn, N. Y.
Schwoyer, John Bieber,	Ch.E.,	Kutztown.
Seippel, John Herman,	C.E.,	Baltimore, Md.
Sexton, Donald Southworth,	M.E.,	Germantown.
Shockley, Henry Wood,	M.E.,	Wilmington, Del.
Sinclair, Carroll Taylor,	E.E.,	Baltimore, Md.
Sloman, Harold Jandorf,	E.M.,	Baltimore, Md.
Smith, Raymond Willard,	E.E.,	Allentown.
Smith, Walter Sumpter,	E.E.,	Birmingham, Ala.
Spies, Arthur Theodore,	E.E.,	Baltimore, Md.
Spuhler, Harry John, jr.,	Met.,	Pittsburgh.
Stokes, Camillus Baker,	C.E.,	Rockville, Md.
Sugden, Harry Carlyle,	Math.,	Bethlehem.

Tate, Albert Austin,	Bus.,	Worcester, Mass.
Tierney, Edward Michael,	Geol.,	Newtown.
Twombly, Clarence Edward, jr.,	Bus.,	Medford, Mass.
Vreeland, Harold Payne,	C.E.,	Butler, N. J.
Waller, James Murray Stone,	M.E.,	Govans, Md.
Walter, Glen Beam,	B.A.,	Reading.
Walter, Robison Fox,	Ch.E.,	Lebanon.
Wentz, Jesse Faust,	E.E.,	Spring Grove.
Williams, Richard Tillinghast,	Bus.,	Buffalo, N. Y.
Wilson, Christian, jr.,	M.E.,	Greenlawn, N. Y.
Wilson, William Kenneth.	El.Met.,	Glen Ridge, N. J.
Wolfs, Wilfred Henri,	Bus.,	Newark, N. J.
Wright, Berkeley,	C.E.,	Kensington, Md.
Wylie, Hugh,	M.E.,	New Castle, Del.
Youry, William Henry Simmons,	El.Met.,	Newark, N. J.
Zimmerman, John Uriah,	C.E.,	Allentown.
Zollinger, Edward Hanlen,	M.E.,	Harrisburg.

SOPHOMORE CLASS

Class of 1918

	Course	Residence
Achorn, Albert Hopkins, jr.,	Bus.,	Wakefield, Mass.
Alden, Richard Champney,	El.Met.,	Steelton.
Allan, Elwood Maxwell,	El.Met.,	Jermyn.
Ambler, Jesse Paul,	C.E.,	Philadelphia.
Bachert, Homer Allison,	E.E.,	South Bethlehem.
Barthold, William Gregory,	B.A.,	Bethlehem.
Bean, Roscoe Dimond,	E.E.,	Bethlehem.
Beckmann, Fred Jacob,	M.E.,	Hellertown.
Bennes, Benjamin,	B.A.,	Newark, N. J.
Bickley, Frederick Winchell,	Ch.E.,	Newark, N. J.
Bishop, Jacob Ariel,	B.A.,	Chambersburg.
Blasius, Charles Essen,	El.Met.,	Philadelphia.
Boland, William Henry,	B.S.,	Westboro, Mass.
Boyd, Harold Gilbert,	Ch.E.,	Scranton.
Breen, John Joseph,	C.E.,	Allentown.
Breinig, Paul Glose,	C.E.,	Allentown.
Brinton, Robert Henry,	C.E.,	Oxford.
Brown, Albert Kenneth,	M.E.,	Bethlehem.
Brucher, Adam, jr.,	B.A.,	South Bethlehem.
Buchanan, Andrew Edward, jr.,	Ch.E.,	Harrisburg.

Burros, Louis,	Ch.E.,	Scranton.
Butz, Thomas Franklin,	M.E.,	Allentown.
Campbell, Robert Shaw,	M.E.,	Pittsburgh.
Carlz, Joseph Franklin,	M.E.,	Gloucester, Mass.
Chang, Shao Lien,	Ch.E.,	Shanghai, China.
Chapman, Lester Nathaniel,	E.M.,	Wollaston, Mass.
Choe, Shu,	E.M.,	Talifu, China.
Clymer, Jay Phaon,	M.E.,	Lebanon.
Coleman, James Harvey, jr.,	Bus.,	Pittsburgh.
Collins, Laurence Elwyn,	Geol.,	Baltimore, Md.
Concilio, August,	E.E.,	Newton, N. J.
Constine, John,	E.M.,	Wilkes-Barre.
Corrigan, Edward Thomas,	B.A.,	Rockledge.
Covell, Edward Hall,	M.E.,	Oxford, Md.
Crawford, George Marter,	E.M.	Wilmington, Del.
Creer, Robert Lewis,	C.E.,	Philadelphia.
Davidson, Edward Crawford, jr.,	E.M.,	Elizabeth, N. J.
Davis, William Milford,	Ch.E.,	Cleveland, O.
Dawson, Lawrence Allnutt,	Bus.,	Rockville, Md.
Deans, Charles Woodbury,	Chem.,	Wilmington, Del.
DeLaney, Roy Everett,	Bus.,	Wilkinsburg.
Dmytrow, Nestor, jr.,	M.E.,	Bethlehem.
Dodson, Weston,	E.M.,	Bethlehem.
Doushkess, William,	Chem.,	New York, N. Y.
Dow, Neal,	Ch.E.,	Sioux Falls, S. D.
Downey, Samuel Boyd, 2nd,	C.E.,	York.
Early, John Joseph,	Chem.,	Campello, Mass.
Ely, Allen Judson,	M.E.,	Red Bank, N. J.
Fenstermacher, Lloyd Carroll,	Geol.,	Reading.
Fritchman, Leon Apple,	B.A.,	Freemansburg.
Gangloff, Thomas Waddell,	Chem.,	Dallas.
Gaston, William Isaac,	M.E.,	Montclair, N. J.
Geis, Leonard Bailey,	E.M.,	Philadelphia.
Gilroy, Frederic Arthur,	Bus.,	Mount Vernon, N. Y.
Golding, Harold Frederick,	Bus.,	Trenton, N. J.
Gonzales, Fernando,	C.E.,	City of Mexico, Mexico.
Goodman, Joseph Seldon,	Bus.,	South Bethlehem.
Grace, Albert Paul,	Biol.,	Brooklyn, N. Y.
Graham, Charles, jr.,	Geol.,	Scranton.
Gross, Charles Franklin,	M.E.,	Bethlehem.
Halsted, William Tyler,	El.Met.,	Brooklyn, N. Y.

Hartzell, Ralph,	M.E.,	Stewartstown.
Heffelfinger, Roy Harold,	Chem.,	Palmerton.
Hogg, John Webb,	M.E.,	Washington, D. C.
Holmes, Joseph Austin, 2nd,	E.M.,	Washington, D. C.
Hooper, Adrian Everett, jr.,	M.E.,	Hammonton, N. J.
Hukill, Francis Williams,	E.M.,	Middletown, Del.
Hunter, James Alfred,	E.E.,	Allentown.
Hutchinson, Harold Spencer,	C.E.,	Flushing, N. Y.
Hyatt, Charles Scott,	Met.,	Cambridge, O.
Igoe, Walter Joseph,	Bus.,	Jersey City, N. J.
Inge, Thomas Roy,	B.A.,	Winston-Salem, N. C.
Jacob, James Baird,	C.E.,	Louisville, Ky.
Jenkins, Lloyd Gladstone,	M.E.,	Drifton.
Jennings, Clifford Milton,	Biol.,	Newark, N. J.
Jennings, William West,	Bus.,	Duncannon.
Johnson, Meredith Esrey,	E.M.,	South Bethlehem.
Jones, Gordon Franklin,	E.E.,	Irwin.
Kay, Morton Joseph,	El.Met.,	Harrisburg.
Keat, Samuel Harold,	Ch.E.,	Orange, N. J.
Keifer, Boyd Ernest,	M.E.,	Bethlehem.
King, Henry Kendall,	M.E.,	Dumbarton, Va.
Klotz, Edgar Lewis,	M.E.,	Davenport, Cal.
Knight, LeRoy Fowler,	E.M.,	Scranton.
Krom, Frederick Brewer, de Hamel,	Bus.,	Plainfield, N. J.
Laguette, Louis Albert,	Bus.,	El. Paso, Texas.
Lambert, Robert Stanley,	B.A.	Sherburne, N. Y.
Latimer, John McChesney,	C.E.,	Washington, D. C.
Lawall, George Ralph,	E.E.,	Allentown.
Lebowitz, Charles Maxwell Alton,	Ch.E.,	Scranton.
Lees, George Edward, jr.,	E.M.,	Bethlehem.
Lind, Carl Oscar,	Chem.,	Brockton, Mass.
Lindsay, Russell Hess,	E.E.,	Harrisburg.
Lu, Cheng-Chih,	E.E.,	Canton, Kwangtung, China.
Lytle, Lawrence DeWitt,	Ch.E.,	California.
McCarthy, John Donald,	E.M.,	Huntingdon.
McConnell, John,	Met.,	Butler.
McCullough, Robert Weldon, jr.,	C.E.,	Jersey Shore.
McGalliard, David Cubberley,	E.E.,	Trenton, N. J.
McGrath, Philip Lawrence,	Bus.,	West Roxbury, Mass.
McKay, John,	Ch.E.,	Philadelphia.

McLaughlin, Harvey Fessenden,	Ch.E.,	Baltimore, Md.
McQuinn, Charles Edgar,	C.E.,	Baltimore, Md.
Maccallum, Walter Herbert,	Ch.E.,	Phoenixville.
Maginnes, William David,	Biol.,	Boston, Mass.
Mayers, Augustus Greth,	Ch.E.,	Reading.
Metzner, Robert Brakmann,	M.E.,	Wheeling, W. Va.
Mitman, William Tobias,	El.Met.,	South Bethlehem.
Mizel, Maynard,	E.M.,	Brooklyn, N. Y.
Moench, John Christopher,	Bus.,	Gowanda, N. Y.
Moll, Homer Isaac,	E.E.,	Strausstown.
Mooers, Edward Allen,	Ch.E.,	Elmira, N. Y.
Morrissey, Martin Alphonsus,	Ch.E.,	South Boston, Mass.
Munkelwitz, Norman Ralph,	E.E.,	Sayville, N. Y.
Neyer, Harold Joseph,	M.E.,	Summit Hill.
Nichols, Russell Mabbatt,	Bus.,	Branford, Conn.
O'Neill, Harold Edwyn,	B.A.,	Altoona.
Osgood, Frank George,	Chem.,	Laconia, N. H.
Ostrom, George Edgar,	Bus.,	Stillwater, Minn.
Oswald, William Hunter,	Bus.,	Cumberland, Md.
Palmer, Stephen Hyer, jr.,	E.M.,	Milford.
Parker, John Wesley, jr.,	C.E.,	Germantown.
Parrish, Calvin Ray,	C.E.,	Kingston.
Penman, Walter Raymond,	M.E.,	Hazleton.
Perry, James deWolf,	Bus.,	Germantown.
Perry, Robert Swain, jr.,	Ch.E.,	Germantown.
Phillips, Hugh Jackson, jr.,	M.E.,	Washington, D. C.
Platt, John, jr.,	Biol.,	Westfield, N. J.
Prickitt, Joseph Mann,	Bus.,	Burlington, N. J.
Purple, Ansel Lieberknecht,	C.E.,	Columbia.
Randall, Arthur Heckford,	Ch.E.,	Bloomfield, N. J.
Reed, Ralph Raymond,	M.E.,	Orwigsburg.
Repko, Rudolph Raymond,	E.M.,	Queens, N. Y.
Richards, Samuel Simes, jr.,	Ch.E.,	Wayne.
Ritter, Karl Lawrence,	B.A.,	South Bethlehem.
Roeder, David Schoenly,	B.A.,	Hosensack.
Roest, Henry Nils,	C.E.,	Bethlehem.
Root, Herbert Dean,	C.E.,	Elizabethtown.
Ruff, Charles Frederick,	C.E.,	Philadelphia.
deSa, Angelo,	E.E.,	Bahia, Brazil.
Sardina, Domingo Hernandez,	C.E.,	Havana, Cuba.
Sargeant, Leonard, 3rd,	E.M.,	Washington, D. C.
Saxman, Marcus Suydam,	E.M.,	Latrobe.

Schmich, John Emil,	E.E.,	South Bethlehem.
Schnerr, Leon Harold,	C.E.,	Peckville.
Schultz, Alfred Schultz,	B.S.,	East Greenville.
Schulz, William Chisholm,	Met.,	Bethlehem.
Sexton, Wray Edwards,	Math.,	Newark, N. J.
Shartle, Harold Frantz,	C.E.,	Lancaster.
Shepherd, Henry,	Bus.,	Shepherdstown, W. Va.
Sheriff, Owen Ritter,	M.E.,	Brooklyn, N. Y.
Smink, Frank Edmund,	C.E.,	Reading.
Snyder, Charles Arthur,	E.E.,	Hammonton, N. J.
Snyder, Walter Overton,	M.E.,	Baltimore, Md.
Solt, Marvin Reinhard,	Math.,	Northampton.
Sommers, Alexander Curtiss,	Ch.E.,	Petersburg, Va.
Speakman, Franklin Baily,	Ch.E.,	Strathmere, N. J.
Staats, Victor Bartmann,	B.A.,	Hoboken, N. J.
Staats, William Thomas,	C.E.,	Philadelphia.
Steacy, Henry Hershey,	M.E.	York.
Stettler, Ray Mantz,	M.E.,	Slatington.
Stotz, Norman Irwin,	Met.,	Ingram.
Summy, Ralph Victor,	Math.,	Manheim.
Sun, To Shuen,	Ch.E.,	Anhui, Show-Chow, China.
Swanger, John Henry,	C.E.,	Lebanon.
Tachovsky, John Philip,	M.E.,	South Bethlehem.
Thomas, Ralph Payne,	E.M.,	Dorranceton.
Thomas, Ross Raymond,	M.E.	Hammonton, N. J.
Tizard, William Essen,	E.M.,	Philadelphia.
Treser, Albert P.,	C.E.,	New Castle.
Vance, Stratton,	E.M.,	Port Washington, N. Y.
Wait, Edgar Fritz,	E.E.,	Johnstown.
Walther, William Max,	Bus.,	Weehawken, N. J.
Wang, Ching Hsien,	C.E.,	Tientsin, China.
Weber, George Esch,	C.E.,	Linwood.
Weber, Howard Hill,	E.E.,	York.
Weiss, John Joseph Richard,	M.E.,	South Bethlehem.
Werner, Paul Erhard,	Math.,	Bangor.
Whitney, John Robertson,	Bus.,	Sunapee, N. H.
Wilford, Paul Rodman,	C.E.,	Bangor.
Wolcott, Robert Wilson,	Biol.,	Sewickley.
Yetter, Gilbert Lignori,	Met.,	Steelton.

FRESHMAN CLASS

Class of 1919

	Course	Residence
Adams, Frederick Quincy,	Bus.,	Worcester, Mass.
Aldrich, Percy Westbrook,	E.E.,	Milford.
Amick, Walter Park,	M.E.	Philadelphia.
Arellano, Alberto Ramirez,	E.E.,	Havana, Cuba.
Atkins, Charles Miner, 3rd,	E.M.	Pottsville.
Barefoot, John Sterrett,	C.E.,	Milroy.
Barrett, Harold George,	Bus.,	Leominster, Mass.
Barthold, Gilbert Edkin,	Geol.,	Bethlehem.
Baskin, Joseph,	Chem.,	Allentown.
Baumann, Lewis Albert,	Ch.E.,	Washington, D. C.
Beard, John,	M.E.,	Germantown.
Benavides, Ramon Lorenzo,	E.E.,	Havana, Cuba.
Berger, Edgar Milton,	M.E.,	Allentown.
Betts, Herbert Patterson,	M.E.,	East Orange, N. J.
Bevier, Kenneth Miller,	Bus.,	Brooklyn, N. Y.
Bigelow, Laurence Theodore,	Bus.,	Minneapolis, Minn.
Blair, George William,	E.E.,	Cresson.
Blodgett, Charles Lenox,	Biol.,	Trenton, N. J.
Bosch, Joseph Mario,	E.E.,	Santiago, Cuba.
Bothe, Henry,	C.E.,	Santiago, Cuba.
Bottomley, Bertram Swaile,	E.M.,	Roanoke, Va.
Bowman, Vernon,	Math.,	Williamsport.
Bradley, James, jr.,	Math.,	New York, N. Y.
Bray, Thomas Joseph, jr.,	E.E.,	Youngstown, O.
Bresee, James Randall,	Ch.E.,	Greene, N. Y.
Brockman, Charles Joseph,	B.A.,	Nazareth.
Buckley, Harold Monroe,	E.E.,	Allentown.
Buckley, Malcolm Kee,	Chem.,	Allentown.
Bugbee, Alvin Newton,	C.E.,	Trenton, N. J.
Bull, Hempstead Stratton,	E.E.,	Fairbury, Ill.
Burgess, George Paul,	Ch.E.,	Joliet, Ill.
Bush, Isaac Moyer,	Ch.E.,	Glenside.
Cahall, William Cannon, jr.,	Bus.,	Germantown.
Campbell, Robert Joshua,	C.E.,	South Bend, Ind.
Campbell, Wellington Foote,	C.E.,	Short Hills, N. J.
Carbonell, José Manuel,	E.M.,	Barranquilla, Colombia.
Cardin, Carl John,	M.E.,	North Brookfield, Mass.
Carr, Peter Aloysius,	C.E.,	Freeland.

Casey, William Ralph,	M.E.,	Springfield, Mass.
Cavanaugh, Joseph,	Ch.E.,	Quakertown.
Clark, William Carroll,	E.E.,	West Chester.
Clarke, Sheldon Vanderbilt,	Bus.,	Williamsport.
Claxton, Edmund,	Chem.,	Berlin, N. J.
Clewell, George Aubrey,	E.M.,	Bethlehem.
Clifford, William Hewitt,	C.E.,	Lenox, Mass.
Coffin, Roy Riddell,	Bus.,	Germantown.
Cohen, William Milton,	Bus.,	New York, N. Y.
Cohn, Ross Alexander,	B.A.,	Baltimore, Md.
Connell, Aloysius Francis,	E.M.,	Beaver Brook.
Criswell, William Singer,	Chem.,	Shippensburg.
Denison, Theodore Edward,	Bus.,	Allentown.
De Vout, Anson Wolfinger,	M.E.,	Harrisburg.
Diefenderfer, Wilbur Frederic,	M.E.,	Allentown.
Dimmick, Harold Edgerton,	M.E.,	Westfield, N. Y.
Dinkey, Robert Eugene,	Geol.,	Pittsburgh.
Dixon, Lyman LeRoy,	E.M.,	Flushing, N. Y.
Doan, Gilbert Everett,	B.A.,	Lansdale.
Dodson, James Lake,	E.M.,	Bethlehem.
Dorkin, David,	M.E.,	Bridgeport, Conn.
Doyle, Harry Brinckerhoff,	B.S.,	Mount Vernon, N. Y.
Drezner, Henry Sydney,	B.A.,	Hazleton.
Eisenhard, Ray Long,	Met.,	Allentown.
Engle, Artemus Bertine,	Met.,	Bethlehem.
Fegley, Claud Andrew,	B.A.,	Bethlehem.
Feringa, Peter Anthony,	E.M.,	Grand Haven, Mich.
Flory, Clyde Reuben,	B.A.,	Edelman.
Flynn, William Joseph, jr.,	Bus.,	Fall River, Mass.
Forstall, Alfred Edmond, jr.,	Bus.,	Montclair, N. J.
Fredenburg, Mark N.,	Chem.,	Newton, N. J.
Freedom, Leon,	E.M.,	Baltimore, Md.
Ganter, George A.,	E.M.,	New York, N. Y.
Gardiner, Joseph Wilkins, jr.,	Ch.E.,	Philadelphia.
Gerber, Ivan Preston,	Ch.E.,	York,
Gildersleeve, Gordon Hamilton,	E.E.,	East Orange, N. J.
Gilman, Charles Grafley,	E.M.,	Philadelphia.
Ginder, Howard David,	Ch.E.,	Scranton.
Gorisse, Curtis Buttz,	C.E.,	Quakertown, N. J.
Gross, James Lewis,	Geol.,	Dauphin.
Grubb, Walter Cuthbert,	El.Met.,	Bangor.
Grübnau, George Malpass,	E.M.,	Wyncote.

Gulick, Henry Burr,	Math.,	Brooklyn, N. Y.
Haines, John Benjamin,	E.E.,	Allentown.
Hall, Elwood Monroe,	Ch.E.,	Allentown.
Hall, William McLaurine, jr.,	Ch.E.,	Parkersburg, W. Va.
Halliwell, Roger Davis,	Biol.,	Bethlehem.
Hallowell, Percy Louis,	Bus.,	Conshohocken.
Hampton, Stanlee Robbins,	E.M.,	Tracy City, Tenn.
Hantz, Benjamin Franklin,	M.E.,	York.
Harder, Frank Kenneth,	Bus.,	Mount Vernon, N. Y.
Hardy, John Forster,	M.E.,	Crafton.
Harris, Walter Williams,	C.E.,	Scranton.
Hartney, Edwin Adams,	B.A.,	Bethlehem.
Harwi, Lawrence Hartman,	Math.,	Bayonne, N. J.
Haussmann, Alfred Carl,	B.A.,	Rockledge.
Hayes, Charles Ellis,	Ch.E.,	Trenton, N. J.
Hazeltine, Frederick Gordon Burnham,	Ch.E.,	Miami, Fla.
Heether, Edward Paul,	Ch.E.,	Williamsport.
Heilman, John Beaver,	E.E.,	Lebanon.
Heimbach, Karl Erdman,	E.E.,	Allentown.
Heller, Abraham,	B.A.,	Claremont, N. H.
Hesselschwerdt, Fred Henry,	Ch.E.,	Buffalo, N. Y.
Heuchel, Harry John,	B.S.,	Brooklyn, N. Y.
Heuer, Richard John,	Bus.,	Philadelphia.
Hicks, Albert Willet, jr.,	E.M.,	Allentown.
Hiller, Harold Sprague,	B.A.,	Washington, D. C.
Hoffman, Vernon,	Geol.,	Pottersville, N. J.
Howard, John Myers, jr.,	M.E.,	Latrobe.
Hunt, Clarkson Toms,	M.E.,	Lansdowne.
Hurley, Robert Augustine,	C.E.,	Bridgeport, Conn.
Iobst, Edgar Henry,	C.E.,	Emaus.
James, Richard Thomas,	El.Met.,	Palmerton.
Jennings, Ross Swartz,	Bus.,	Duncannon.
Jeter, Everett Vail,	B.A.,	Dallas.
Johnson, Ralph Franklin,	C.E.,	Washington, D. C.
Johnson, Walter Morgan,	C.E.,	Washington, D. C.
Jones, George Parker,	B.A.,	Freeland.
Jones, George Sinks,	Bus.,	Youngstown, O.
Keim, Rollin Reuben,	Ch.E.,	Bethlehem.
Keith, Isham, 3rd,	E.E.,	Warrenton, Va.
Kemmerer, Paul Harry,	E.E.,	Emaus.

Kennedy, James Neilson,	Met.,	Youngstown, O.
Kepner, Charles Andrew,	Ch.E.,	Allentown.
Ketcham, David Hallock,	M.E.,	Huntington, N. Y.
King, Louis Garrison,	M.E.,	Allentown.
Kirby, John Burk,	C.E.,	Yardville, N. J.
Kirk, Herbert Spencer,	Ch.E.,	New Castle.
Knickerbocker, John Cole, jr.,	Bus.,	Albion, N. Y.
Knubel, John Albert,	C.E.,	New York, N. Y.
Koplin, George Deemer,	M.E.,	Kingston.
Korves, Albert Anthony,	E.M.,	South Bethlehem.
Krohn, William,	B.A.,	Easton.
Lacouture, Carlos Hugues,	Math.,	Magdalena, Colombia.
La Pish, George Benjamin,	Bus.,	South Bethlehem.
Lauder, Beeton Pullman,	M.E.,	Bridgeport, Conn.
Lawrence, Morris,	Ch.E.,	Scranton.
Lee, Richard Henry, jr.,	E.M.,	Lebanon.
Lehr, Edward Victor,	B.A.,	Haddonfield, N. J.
Lessig, Daniel Kepner,	M.E.,	Pottstown.
Leverich, Leonard Phillips,	Bus.,	Brooklyn, N. Y.
Lewis, Levi Roy,	M.E.,	Clarks Summit.
Lidman, William Samuel,	E.E.,	Norfolk, Va.
Linderman, Robert Seymour,	E.M.,	Beverly, N. J.
Lloyd Grier,	M.E.,	Hazleton.
Lloyd, Russell Gray,	E.M.,	Wilkes-Barre.
Lord, John Jacob,	C.E.,	Tower City.
Ludlow, Raymond Woodruff,	Bus.,	Camden, N. J.
MacGregor, Louis Jones,	M.E.,	Carlisle.
McComas, James Anderson,	Ch.E.,	Baltimore, Md.
McKinley, William Bradley,	B.A.,	Olyphant.
Macdonald, George Ranold,	Bus.,	Dorchester, Mass.
Manley, Milton Augustus,	Bus.,	Newton, N. J.
March, Walter Stokley, jr.,	E.M.,	Cynwyd.
Melville, C. Glennon,	C.E.,	Harrisburg.
Memmert, Paul William,	B.A.,	Easton.
Mertz, Charles Dorney,	M.E.,	Girardville.
Miller, Frank William,	C.E.,	Reading.
Miller, Roland Kline,	Bus.,	Northampton.
Monie, Charles,	E.M.,	Moosic.
Mora, Arnobio Bernardo,	E.M.	Loja, Ecuador.
Mulford, Edward Mortimer, 3rd,	M.E.,	Brooklyn, N. Y.
Murray, James Ratcliffe,	E.E.,	Baltimore, Md.

Nawrath, Frederick Dent,	M.E.,	Newark, N.J.
Nicholas, Andrew John,	M.E.,	Eckley.
Nutter, Clyde,	Bus.,	Rochester, N. H.
Oberrender, Graaf,	Bus.,	DuBois.
O'Neill, Thomas Carson, jr.,	E.M.,	Altoona.
Ostrolenk, Ludwig,	E.E.,	Canby, Minn.
Overton, Sereno Burnell,	M.E.,	Southampton, N. Y.
Owen, Lincoln Sullivan,	Ch.E.,	Niagara Falls, N. Y.
Park, Jacob Willever,	Ch.E.,	Port Murry, N. J.
Parlour, Clarence Henry,	B.A.,	Allentown.
Peale, Rembrandt, jr.,	Geol.,	New York, N. Y.
Peaty, Arthur Francis,	M.E.,	Essex Fells, N. J.
Probasco, Samuel Risler,	C.E.,	Burlington, N. J.
Pursel, Harold Reinhardt,	M.E.,	Danville.
Quist, Albert James,	Bus.,	Everett, Wash.
Randolph, Calvert Stuart,	M.E.,	East Orange, N. J.
Reed, Lawrence Frank,	M.E.,	Orwigsburg.
Reid, Armour Lionel,	Ch.E.,	Glen Ridge, N. J.
Reid, Ricklef Allen,	E.E.,	Glen Ridge, N. J.
Richards, John Thomas, jr.,	E.E.,	Hazleton.
Robertson, Guy Richmond,	C.E.,	New York, N. Y.
Rogers, William Anderson,	Math.,	Brooklyn, N. Y.
Rohrer, Robert Travers,	M.E.,	Washington, D. C.
Rome, Robert Charles, jr.,	Ch.E.,	Brooklyn, N. Y.
Rosenbaum, Robert,	Geol.,	Philadelphia.
Rosenmiller, Joseph Lewis,	Math.,	York.
Rowand, Ellwood Montgomery, jr.,	M.E.,	Haddon Heights, N. J.
Ruhf, Harold James,	Ch.E.,	Brooklyn, N. Y.
Saylor, Edward Templin,	Bus.,	Reading.
Schaub, William Otto,	C.E.,	Baltimore, Md.
Schelden, Harry Miles,	E.M.,	Allentown.
Schley, John Reading,	Met.,	Frederick, Md.
Schrader, William D.,	E.M.,	Allentown.
Schubert, Charles Samuel,	E.M.,	Roanoke, Va.
Schuler, John Hamilton,	Ch.E.,	Gadsden, Ala.
Schultz, William Reed,	El.Met.,	Morristown, N. J.
Sefing, Frederic George,	El.Met.,	Allentown.
Seligman, Lawrence Fraley,	Bus.,	Tamaqua.
Senderowitz, Morris,	Bus.,	Allentown.
Shafer, Alfred Elwood Morton,	E.E.,	Lehighton.
Shaffer, Carl Judson,	E.M.,	Pittsfield, Mass.

Shannon, Richard Harland,	C.E.,	Bridgeport, Conn.
Sherman, John,	C.E.,	Roanoke, Va.
Sherry, Marlow Wilke,	E.M.,	Allentown.
Sherts, Amos LeFevre,	C.E.,	Lancaster.
Shimer, Jacob Manton,	M.E.,	Bethlehem.
Shipherd, John Jay,	Ch.E.,	Evansville, Ind.
Shirk, William Blottenberger,	E.E.,	Lebanon.
Simmons, Milton Charles,	Math.,	South River, N. J.
Skillman, John Malcolm,	E.E.,	New Germantown, N. J.
Smith, Edward Percy,	Bus.,	Millville, N. J.
Smith, Harold D. W.,	Math.,	Bayonne, N. J.
Smith, James Allan,	El.Met.,	Steelton.
Smith, Paul Klugh,	Bus.,	York.
Sourber, James David,	B.A.,	Pottsville.
Spillman, Otto Henry,	C.E.	Bethlehem.
Steacy, Frank Henley,	Bus.,	Columbia.
Stevens, A. C.,	C.E.,	Mount Vernon, N. Y.
Stevens, John Malcolm,	B.A.,	Montclair, N. J.
Stofflet, Russell Steward,	Chem.,	Delabole.
Storb, Henry Mentzer,	E.E.,	New Holland.
Stotz, Edward, jr.,	C.E.,	Ingram.
Stroup, Horace Clifford,	B.A.,	Johnstown.
Stull, Robert Alan,	M.E.,	Wilkes-Barre.
Sullivan, James Edward,	Bus.,	Dorchester, Mass.
Thomas, George Clair,	Biol.,	Sunbury.
Thompson, George Stephen,	M.E.,	Shaft.
Tinker, Edward Lay,	E.E.,	West Haven, Conn.
Tomkinson, Charles Hoyt,	M.E.,	Netherwood, N. J.
Tomlinson, Charles Nicholas Wheaton,	E.M.,	Aurora, Ill.
Traylor, Samuel William, jr.,	Math.,	Allentown.
Tsai, Hsiung,	E.M.,	Hu-chow,Chekiang,China.
Twombly, Edwin Parker,	Bus.,	Groveland, Mass.
Uhl, Edwin Roy,	E.E.,	Mount Savage, Md.
VanAuken, Frank Harding,	M.E.,	Glen Ridge, N. J.
Wagner, John Harold,	C.E.,	Harrisburg.
Wagoner, Gillson Richard, jr.,	M.E.,	Philadelphia.
Walker, Joseph Beidler,	M.E.,	Blue Bell.
Walters, Harold Rodman,	B.A.,	Bethlehem.
Warner, Clarence William,	Met.,	East Orange, N. J.
Warner, Warters Rice,	M.E.,	Kenvil, N. J.

Wear, Paul Guy,	Ch.E.,	Bethlehem.
Weber, Charles William,	M.E.,	Abington.
Weikel, John Henry,	M.E.,	North Wales.
Whigham, William, jr.,	M.E.,	Pittsburgh.
Whitney, Edward Foote,	M.E.,	Sherburne, N. Y.
Widmyer, John Henry,	Chem.,	Lancaster.
Wilbur, Robert Alexander, jr.,	Ch.E.,	Elmira, N. Y.
Willard, Bradford,	Geol.,	Plainfield, N. J.
Winterhalter, William Charles, jr.,	Math.,	Crafton.
Wolbach, Charles Albert,	B.A.,	Riegelsville.
Woolley, Walter R.,	E.E.,	Asbury Park, N. J.
Wright, Eugene Conner,	B.A.,	Honeybrook.
Yap, Alfred Tsun Leong,	Bus.,	Honolulu, Hawaii.
Yard, Charles Frederick,	C.E.,	Trenton, N. J.
Zeller, Theodore Cyril,	B.A.,	McKeesport.

SPECIAL STUDENTS

	Course	Residence
Bame, Lynn Huntington,	C.E.,	Lancaster, N. Y.
Benner, Joseph Henry,	B.A.,	Bethlehem.
Chiang, Chao Hsi,	M.E.,	Foochow, China.
Frampton, John Alonzo,	B.A.,	Scranton.
Hommel, Rudolph P.,	Chem.,	Bethlehem.
Igarashi, Tadao,	El.Met.,	Tokyo, Japan.
Johnson, Fred deForest,	B.A.,	New York, N. Y.
Lewis, Arthur Wyndham,	Bus.,	Martins Ferry, O.
Linn, Tse I.,	E.M.,	Tsinan, Shantung, China.
Neafie, William Otis,	C.E.,	Spring Lake Beach, N. J.
Nesselbush, Louis Michael,	Met.,	Buffalo, N. Y.
Scatko, Joseph John,	M.E.,	South Bethlehem.
Woo, Chienton Chenlott,	Ch.E.,	Pucheng, Fukien, China.
Yates, Walter Ames,	Met.,	Buffalo, N. Y.

SUMMER SCHOOL STUDENTS

(Whose names do not appear in the preceding lists but who attended Summer School only.)

	Course	Residence
Benson, Arthur Francis,	M.E.,	Wenonah, N. J.
Cranmer, Harold Drinker,	C.E.,	South Bethlehem.
Desmond, John Kenneth,	C.E.,	Philadelphia.
Dupuy, Alberto,	C.E.,	Bogota, Colombia.
Ewing, Paul Albert,	C.E.,	Washington, D. C.
Flannelly, George John,	B.A.,	Dunmore.
Gonsalves, R. R.,	C.E.,	Guaratingueta, Sao Paulo, Brazil.
Good, Robert Charles,	M.E.,	Camp Hill.
Gunn, Malcolm Burgless,	M.E.,	Burlington, N. J.
Hanford, James Lawrence,	E.M.,	Morgantown, W. Va.
King, Robert Charles,	B.S.,	South Bethlehem.
Riegel, C. H.,	M.E.,	
Spear, William Perkins,	Bus.,	Middletown, Conn.

STUDENTS IN EXTENSION COURSES

The following are names of persons, who are not matriculated students of the University but who are taking courses for which a certificate of collegiate credit is issued. This list does not include those who have merely registered for lecture courses or who attend the Lehigh Evening School. The extension courses are described on page 115.

The numbers following the names indicate the courses pursued, as follows: 1, Bases of English Grammar; 2, Advanced German; 3, Philosophy; 4, Educational Psychology; 5, Advanced French; 6, Elementary Chemistry; 7, Elementary Physics; 8, Elementary French.

Allen, Edna M.,	4	Allentown.
Allen, Mary G.,	4	Allentown.
Balliet, Clara M.,	4	Allentown.
Berger, Helen C.,	3	Bethlehem.
Biehn, Edna M.,	3	Quakertown.
Bishop, Louise Antoinette,	3, 4	Bethlehem.
Bishop, Sarah Emily,	3, 4	Bethlehem.
Blumer, Emily M.,	4	Allentown.
Canam, Isabel H.,	4	Bethlehem.

Christ, J. Raymond,	1	Bethlehem.
Collins, Veronica L.,	3	Bethlehem.
Collmar, Mrs. Norma McFall,	6	Easton.
Denberger, Edith L.,	3	Bethlehem.
Eden, Sylvia A.,	3	Upper Mountain, N. J
Fahl, Stella R.,	2	Bethlehem.
Flory, Clyde,	2	Edelman.
Frankenfield, Ira Myers,	1, 2	Coopersburg.
Fretz, Peter Claude,	2	Hellertown.
Funck, Selma C.,	3	Tompkinsville, N. Y.
Harrar, Fanny Morgan,	3	Lansdale.
Hesse, Marie,	2	Bethlehem.
Hicks, Margaret Virginia,	3	Newark, N. J.
Himmelreich, Walter Fassanacht,	1, 2	Hellertown.
Hoch, Helena Margaret,	2, 4	Bethlehem.
Hommel, Rudolf P.,	6	Bethlehem.
Hughes, Mrs. Percy,	3	South Bethlehem.
Jefferson, Mary Heitshu,	3	Memphis, Tenn.
Johnson, Lloyd R.,	7	Asbury, N. J.
Kistler, Annie B.,	4	Allentown.
King, Robert C., A.B., (*University of Missouri*)	2	Bethlehem.
Koons, Elizabeth Carrie,	4	Allentown.
McNamara, John Joseph,	1, 2	South Bethlehem.
Miller, Robert Hume,	5	Bethlehem.
Murray, Annie Victoria,	1, 6, 8	Bethlehem.
Pohl, Elizabeth Shimer,	2	Easton.
Pohl, Ida Margaret,	2	Easton.
Rausch, Herbert S.,	7, 8	Perkasie.
Spatz, E. Margaret,	4	Allentown.
Strunk, Elvira M.,	4	Allentown.
Taylor, Mary Sanford,	4	Bethlehem.
Thomas, Mary E.,	4	Bethlehem.
Thomas, Phyllis M.,	3	Bethlehem.
Wolter, Margaret Elizabeth,	3	Bethlehem.
Warmkessel, Emmanuel,	5	Bethlehem.
Wolbach, Charles A.,	2, 6, 7	Richlandtown.

SUMMARY OF STUDENTS BY CLASSES AND COURSES

	Graduates	Seniors	Juniors	Sophomores	Freshmen	Specials	Summer School Students	Totals
Arts & Science	21	20	35	47	82	4	3	212
Civil Eng.....	5	19	25	28	29	2	5	113
Mech. Eng.....	2	24	35	30	45	2	4	142
Mining Eng....	6	10	12	21	29	1	1	89
Metal. Eng.....		1	4	5	5	2		17
Electromet.....	3	1	6	6	5	1		22
Electric. Eng...	6	16	25	16	27			90
Chemistry.....	4	10	4	7	7	1		33
Chem. Eng.....	3	3	9	22	28	1		66
Totals.....	50	104	155	182	257	14	13	775

SUMMARY OF STUDENTS BY STATES

New Hampshire	4
Massachusetts	28
Connecticut	12
New York	69
New Jersey	96
Pennsylvania	418
Delaware	5
Maryland	44
District of Columbia	11

Virginia	12
West Virginia	7
North Carolina	2
South Carolina	1
Alabama	2
Florida	1
Ohio	7
Indiana	2
Illinois	4
Michigan	1
Minnesota	3
Kentucky	1
Tennessee	1
Texas	3
Ohlahoma	1
South Dakota	1
Utah	1
Washington	1
Oregon	1
California	2
Cuba	7
Porto Rico	1
Mexico	1
Honduras	1
Colombia	4
Brazil	3
Ecuador	1
Chile	1
Russia	1
Turkey	1
Hawaii	1
Japan	2
China	10
	775

INDEX